

\$2.15\* NZ \$2.50

NOV 1982

# eti

# ELECTRONICS TODAY INTERNATIONAL

SERIES 5000

# GRAPHIC EQUALISER



**5 CAR COMPUTERS TO WIN!**



**HI-FI.**  
**Quad electrostatic  
speakers reviewed**

**CIRCUIT FILE:** Voltage  
and window comparators

**Digital car alarm system**

**Six super programs  
for the '660 computer**

**Winners of our Grand Hi-Fi Contest announced**

# The average hi-fi designer versus the human ear.

The human ear forms part of a sound receiving system that outperforms the best audio equipment known to science.

Capable of interpreting a dynamic range of 120db or 10 octaves, it has double the capability of any man made electronic equipment.

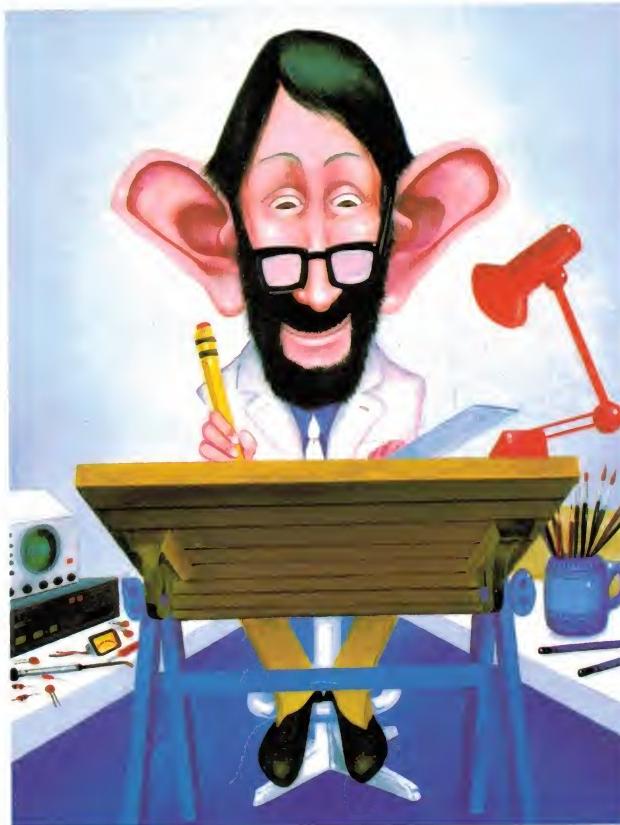
The ear can discern direction, coloration and musical within a complex detail rendition of a 50 piece orchestra in a manner no electronic equipment is able to do.

It is, in short, a sophisticated piece of equipment that should represent the most stimulating challenge to any designer of audio equipment.

Unfortunately it's a challenge that's largely ignored. Which is why in most stereo



systems handling power and volume are substituted for subtlety and frequency response. Vector Research however is one of the few exceptions. Developed by a team of highly experienced audio engineers who



were tired of compromise, Vector Research represents a new standard in high fidelity excellence.

Discussing the Vector VRX 9000, *Stereo Review* states "The receiver surpassed virtually every one of its performance specific ations...it sounds as good as it looks, which is saying a lot..."

*High Fidelity* states "a receiver with such sophisticated performance and functions demands attention." *Popular Electronics* on the Vector VCX 600 cassette deck, "Lower Flutter readings than those of the VCX 600 are hard to find..."

while not cheap, it affords excellent value." *Hi-Fi Buyer's Review* sums up.

"Vector Research is a newcomer to the audio scene, but if the VCX 600 is any guide, this company should be very successful."

If then you are an audiophile whose interest goes beyond famous names and shiny knobs then you owe it to yourself to learn more about Vector Research.

Dear V.R., In my book, beauty is in the ear of the beholder. Send me the test reports and the name of my nearest stockist.

Name \_\_\_\_\_

Address \_\_\_\_\_

Postcode \_\_\_\_\_

Keio International Pty. Ltd.  
198 Normanby Road, South Melbourne 3205.  
Telephone: (03) 643546.

KO 404 ETI

## Vector Research. A fraction better than excellent.

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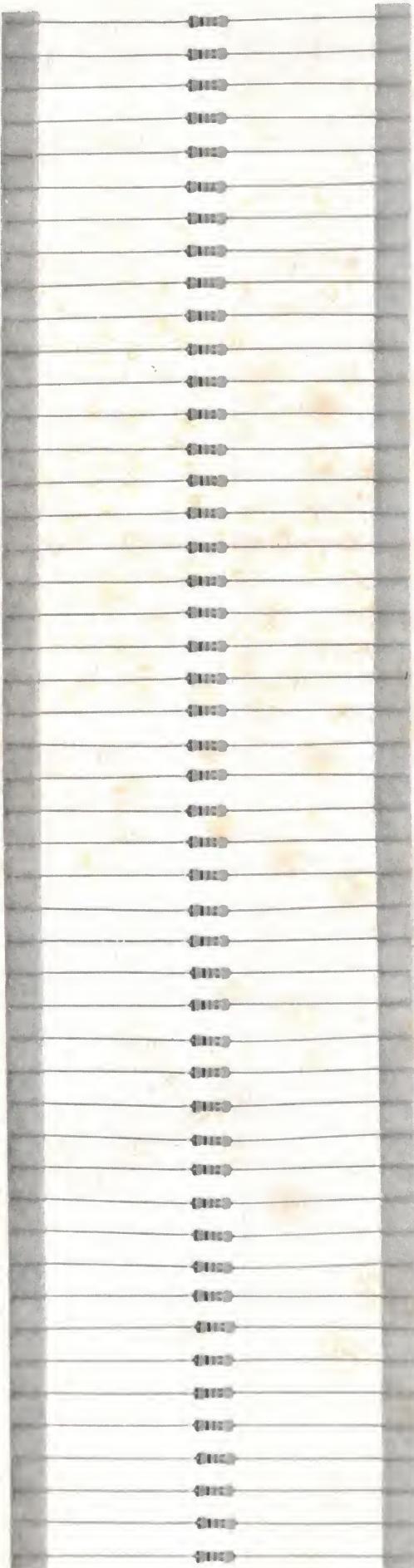
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The cover of the November 1982 issue of Electronics Today International (ETI) magazine. The title 'ELECTRONICS TODAY INTERNATIONAL SERIES 5000' is at the top. Below it is a large image of a 'GRAPHIC EQUALISER' unit. Text on the cover includes '5 CAR COMPUTERS TO WIN!', 'Quad electrostatic speakers reviewed', 'Voltage and window comparators', 'Six super programs for the '660 computer', and 'Winners of our Grand HI-FI Contest announced'. The bottom of the cover has a decorative border.

This month's cover features David Tilbrook's Series 5000 Graphic Equaliser project and the Sparkrite 'Voyager' car computer — five of which can be won in our super contest.

Cover design: Ali White

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# Metal Film technology at carbon prices

## SFR Standard Film Resistors **PHILIPS**

At last. A range of metal film resistors with improved performance over carbon film types, at the low prices you'd expect to pay for carbon film resistors!

We're talking about Philips' new SFR25 range of 5% tolerance — 1/4W metal film resistors. With a quality and price made possible only by advancements in metal film technology and the massive scale of our automated manufacture.

SFR25's feature a 'clean lead' finish and are constructed to the same high standard as the Company's 'MR' series. Resistance coverage from  $1\Omega$  to  $1M\Omega$  (E24 values) with a tolerance of  $\pm 5\%$  is assured. Maximum power dissipation is 0.33W at  $70^\circ\text{C}$  ambient.

They have a noise figure of less than  $0.1\mu\text{V/V}$  (a tenth of the carbon film noise figure) and a temperature coefficient of less than  $250\text{ppm}/^\circ\text{C}$ . Even more important, neither parameter shows degradation with increasing ohmic value. These improvements stem primarily from the homogeneity and stability of the resistive deposition.

So there you have it. Another quality product, ahead of its time, from Philips.

For further information phone:

**Philips Electronic Components and Materials,**  
P.O. Box 50, Lane Cove, 2066. Phone: **Sydney** 427 0888,  
**Melbourne** 542 3333, **Adelaide** 243 0155, **Brisbane** 44 0191  
**Perth** 277 4199.



**Electronic  
Components  
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**Editor**  
Roger Harrison VK2ZTB

**Technical Editor**  
David Tilbrook VK2YMI

**Assistant Editor**  
Jennifer Whyte B.App.Sc.

**Advertising Production**  
John Gerrie

**Advertising Sales**  
Bob Taylor (Group Manager)  
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**Editorial Staff**  
J.B. Scott B.Sc./B.E.(Hons)  
VK2YBN  
Jan Vernon B.A.  
David Currie  
Geoff Nicholls B.Sc./B.E.

**Art Staff**  
Ali White B.A.  
Bill Crump  
Githa Pilbrow

**Typesetting**  
Julie Hewlett

**Reader Services**  
Paula Malone

**Managing Editor**  
Collyn Rivers

**Acoustical Consultants**  
Louis Challis & Associates

**Editorial and Sales Office:**  
4th Floor, 15 Boundary St,  
Rushcutters Bay NSW 2011  
Ph: (02)268-9811; Tlx: 27243

**Melbourne:** Virginia Salmon and Mel Godfrey,  
150 Lonsdale St, Melbourne Vic 3000  
Ph: 662-1222; Tlx AA34340

**Adelaide:** Admedia Group, 24 Kensington Rd,  
Rose Park SA 5067. Ph: 332-8144,  
Tlx AA82182

**Brisbane:** Geoff Horne Agencies, 16 Bellbowrie  
Centre, Bellbowrie Qld 4070. Ph: 202-6813.

**Perth:** C. Thomas, Adrep Advertising  
Representatives, 62 Wickham St, East Perth  
WA 6000.

**New Zealand:** Frank Hargreaves, Circulation  
Marketing Manager, c/- ACP, 4th Floor, Sun  
Alliance House, 42-44 Shortland St, Auckland  
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EC4A 2AL. Ph: 353-1040, Tlx. 267163.

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Services, 15 Sanyecho, Shinjuku-Ku, Tokyo  
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\* Recommended retail price only

## comment

### next month

#### TRAIN CONTROLLER PROJECT

This dual-circuit unit provides throttle and brake controls that work in the same manner as on a 'real' train. The circuitry gives the driver the feel of inertia as well as loading. It can run anything from micro-gauge to twin '0' gauge engines and it's low in cost. More a 'railway controller' than a simple model train controller!

#### 30 V/1 A PROTECTED POWER SUPPLY PROJECT

No electronic hobbyist's bench should be without one! This fully-protected supply is simple to build, low in cost and features both voltage and current metering.

#### POLYPHONIC TOUCH ORGAN PROJECT

Featuring a 'touch' sensor keyboard on the unit's printed circuit board, fully polyphonic capability, two-octave range (F below middle — C to F above), two 'voices' and loudspeaker output, this battery or plugpack operated organ is low in cost and simple to build. The circuitry has been specially designed so that the keyboard is not plagued by finger moisture or humidity problems.

#### WHAT BATTERY?

The widespread availability of low cost CMOS and other devices of staggering complexity and low power demand has led to increasing miniaturisation of a wide variety of electronic equipment. This, in turn, has led to a resurgence in battery operated devices. At the same time, advances in technology have led to some remarkable developments in batteries today. Which type of battery is best, dry cells, NiCads or alkalines? Philip Clark discusses their merits and applications.

#### THE MICROBEE REVIEWED

The Microbee, from Applied Technology, lays claim to being Australia's fastest selling microcomputer. This multiple review examines the microcomputer industry's hottest property and throws up some surprising results.

#### CHIP-8 PROGRAMMING HINTS AND TIPS FOR ETI-660 OWNERS

This article covers a host of useful hints, tips and routines for owners of the ETI-660 Learners' Microcomputer but it should be of interest to any CHIP-8 programmer.

#### THE VECTOR RESEARCH VCX500 CASSETTE DECK

Vector Research is a relatively new name on the Australian hi-fi market. This cassette deck has all the makings of a first class machine with an outstanding appearance, well made electronics, solid construction and performance claims which ought to place the unit in the 'top shelf' bracket.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.



Roger Harrison

Roger Harrison  
Editor

## services

**Mail enquiries:** There is no charge for replies, but a foolscap-sized, stamped addressed envelope must be enclosed. Queries relating to projects can only be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are other than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.

**Phone enquiries:** We can only answer readers' technical enquiries by telephone after 4.30 pm. The number to ring is: (02)33-5669. In enquiring by telephone about back issues or photostats, please ring (02)268-9015.

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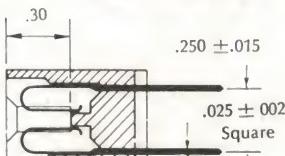
**LIABILITY:** Comments and test results on equipment reviewed refer to the particular item submitted for review and may not necessarily pertain to other units of the same make or model number. Whilst every effort has been made to ensure that all constructional projects referred to in this edition will operate as indicated efficiently and properly and that all necessary components to manufacture the same will be available no responsibility is accepted in respect of the failure for any reason at all of the project to operate effectively or at all whether due to any fault in design or otherwise and no responsibility is accepted for the failure to obtain any components parts in respect of any such project. Further, no responsibility is accepted in respect of any injury or damage caused by any fault in the design of any such project as aforesaid. The Publisher accepts no responsibility for unsolicited manuscripts, illustrations or photographic material.

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store  
now open**  
CARLINGFORD 872 4422

# BOTTOM-OF-THE-HARBOR

WE'VE DREDGED MORE GREAT BARGAINS!!

## S100 Socket Sensation \*



Quantities strictly limited.

ONLY \$4.95 each  
10+ \$4.45 each

A socket of this quality is normally around \$12. Not this bottom of the harbor special! We dealt these from the mighty Yarra!

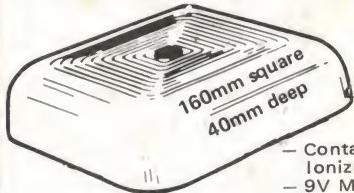
We have secured a bulk-buy of HIGH QUALITY S-100 card edge connectors. Remember! the S-100 Standard is a "queer" 0.125" pitch. Each connector features gold plated bifurcated contacts with wire wrap pins in a Dialyl Phthalate moulded body. If you want to solder into a PCB this is O.K., simply cut the pins down to suit.



## final runout of GE Consumer Products

WE HAVE SOLD OVER 1000 OF EACH OF THESE ITEMS. ONLY A FEW ARE LEFT NOW.  
WHY NOT BUY ONE FOR YOUR MUM?

### Smoke Detector



FROM \$12.50

- Contains Americium 241 Ionization Chamber
- 9V Mallory Duracell included
- Contains very loud solid state buzzer
- 12 month factory warranty.

One of the greatest consumer flops of the last decade was the Ionization Chamber Smoke Detector. Even though it is a brilliant product (reliable compact, easy installation, fail-safe etc) it just did not sell. Human nature being what it is finds safety-oriented products just not worth the investment. We all know that accidents and fires never happen to US!! As smoke is the greatest killer in a fire, the market research gurus thought that such a product would have a wide appeal. When they were \$49.50 no-one wanted them. The price fell to a very reasonable \$29.50 and still they stayed on the shelf. We have now been instructed to clear them for less than 1/2 of \$29.50.

QUANTITY PRICES

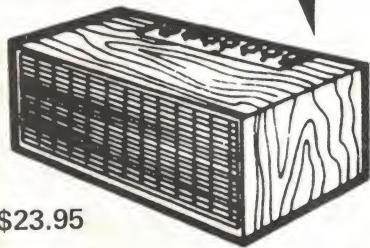


1-\$14.50: 2-5 \$13.50ea: 6-10 \$13.00ea: 10 up \$12.50ea

### Burglar Alarm

GENERAL ELECTRIC

BURGLAR ALARM SLASHED!!!  
HUGE SCOOP PURCHASE –  
ONCE SOLD FOR OVER \$100



FROM \$23.95

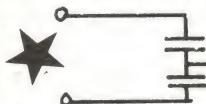
Amazingly low price for a full feature ultrasonic proximity/burglar alarm. + Completely self contained + 12 month manufacturer guarantee + Instant or delayed alarm + Handsome imitation woodgrain + Cabinet measures 180(w)x85(h)x100(d)mm + Programmable multi-code disable switch + Single 9V Alkaline battery\* lasts one year + unit beeps when battery gets low + Contains receiver element designed for greater sensitivity without false triggering + Uses state-of-the-art LSI circuitry + Worth the money in parts alone + Comprehensive 24 page manual included + Comes complete with 4 window deterrent stickers + Absolutely no installation needed \* Battery extra.

1-\$29.50: 2-5 \$25ea: 6-10 \$24.50ea: 10up \$23.95ea

Buy one for Mum for Christmas...

### MainsWidget

Nifty little 2 x 0.1uF 250V ceramic which schematically looks like this:



PACK OF 4  
\$1.00

Ideal to mount across the mains chocolate block with the centre terminal going to earth. Helps prevent mains interference. Found floating in the sea off Bondi!!

### rotary mains switch 99¢

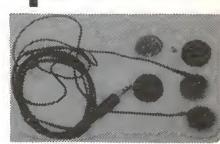
– A 20 year throwback. These days all we do is flick our toggles. In the past a quick twist of the knob turned things on. You can relive this experience with our DPST mains switch. Convenient bushing mount with  $\frac{1}{4}$ " shaft. Ideal replacements. Genuine 240VAC 3 amp rated.



### micro headphones

AS REVIEWED  
SEPT EA Page 45

FEATURES:  
MODEL MT310  
Samarium Cobalt magnets  
102dB/mW  
Weight 15 grams  
Response: 50Hz-20kHz  
Impedance: 32 ohms

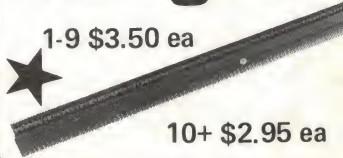


Unit fits into the cusp of your ear. Can be worn under motorcycle helmets. Unbelievably clean sound.

ONLY \$19.50

### \*1 Edgeconnectors \*

1-9 \$3.50 ea



10+ \$2.95 ea

Collectors special. Made by UECL of England. Sold in quantity for over \$10 each. Each Dialyl Phthalate moulded connector contains 170 heavily gold plated bifurcated contacts. (2x 85 way). Each contact is solder eyelet terminated. The connector is 217mm long but you can cut it down to any length you wish. Outstanding quality and they did not get wet after laying at the bottom of the Swan river.

Narrow band-pass type – ideal X'TAL FILTERS for communications equipment. High quality multi-stage unit suitable for precision I.F. work. Incredible value: Manufacturers distress stock, YOU SAVE.

ONLY \$5.00 each (1-9)

worth 4 times this amount.

Oscillator crystals to suit;

10.240MHz or 10.695MHz

ONLY \$2.50 each

10 up on both – less 25%



# BARGAINS

BIG MAL IS CALLING A ROYAL COMMISSION!!

## fibreglass matrix board

Not flimsy Bakelite junk. You will be able to use this board over and over again without deterioration. Measuring a massive 115 x 164mm and contains 2816 x 1.0mm diameter holes. Worth over \$8 but our special for November only \$2.95 each.

Source: Brisbane River.



\$ 2.95

NOVEMBER ONLY

### JUMBO SPEAKER CABLE

Now you can have super-quality cable without breaking the bank! Each conductor contains a MASSIVE 259 strands of 0.12mm wire! It could carry 30 amps! Great for Hi Fi or high power amps.

Only \$2.50/m

100m \$2.00/m



## Walkie Talkies Sensational price for X'tal controlled units



Sensational price for CRYSTAL CONTROLLED UNITS!! Not your super-regen rubbish!!

Don't be fooled! These units actually do work - well in fact. Will transmit voice or Morse over fairly respectable distance (over a mile in ideal conditions). Fitted with proper transmit/receive crystal controlled superhet circuitry. DO NOT COMPARE with far inferior units that may only be a dollar or so cheaper anyway and almost always are a disappointment.

At only \$12.50 each, how could you go wrong?

Place of origin: Botany Bay

only \$12.50

## Factory Seconds ~



YOU COME FIRST...

We have secured a smallish quantity of 5 pin DIN to 4 RCA audio leads that are on the wrong side of the Q.C. inspection. Shame though. Because the DIN plug is ALL METAL and GOLD plated. So are the RCA plugs. Problem is that the gold plating is bubbling on the gold DIN plug. (As far as we can see the 4 gold RCA's are PERFECT.)

An ordinary NICKEL PLATED lead set like this costs around \$4.75. The gold versions normally are around \$9.95. You can have one of these for \$3.95 and that's better than Nickel any day! Worth it for the 4 x RCA's alone!

**value \$3.95**

### NUMERIC KEYPAD ELASTOMERIC

Get in quick!! Only 35 available. High quality 12 button keypad. 0-9 with 2 extra push-buttons. As seen on U.S. style telephones. Measures 76x57x10mm approximately.

\$4.95



new  
store  
now open  
CARLINGFORD 872 4422



## Motorola Piezo \* Horns ~ back in stock

Model KSN 1005A

50 WATT P.A.

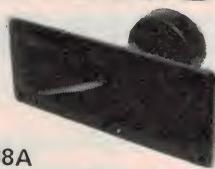
ONLY \$17.00 EACH

Model KSN 1025A

100 WATT P.A.

ONLY \$26.00 EACH

buy  
now



Model KSN 1038A

50 WATT HI-FI/P.A.

ONLY \$17.00 EACH

Model KSN 1039A

50 WATT HI-FI

ONLY \$13.00 EACH



top  
value



## Electric Eels?? \*

No. One metre long 7.5A appliance cords. Each (black) cord has a moulded 3 pin approved mains plug on the end. Why so cheap? Well they ARE only a metre long. But consider this:

- Any benchtop piece of equipment only needs a short mains cord. A long mains cord gets in the way and is positively dangerous!!
- Ideal for power supplies or any bench or rack mounted audio or test equipment.

We have HEAPS. But we have said that before.

Buy in bulk and save. We doubt whether you will ever see mains cords this cheap again.



1-9pcs 69 cents each  
10-24pcs 50 cents each  
25-99pcs 45 cents each  
100 up 39 cents each

GENUINE APPROVED cords from the Parramatta River

## Proximity Switch



1/2  
price

\$ 14.75

Show this time the right way around. In August we advertised this product and the picture showed the 'bum' end facing you. It was sort of like having a sumptuous eye-view of a Ferrari - you didn't see the nice part.

They didn't sell in any case and we're not sure whether it was the photo or not.

So this month we've HALVED the price and showing it to you the right way round.

FEATURES: 12V powered unit. When metal object passes near to target face, output swings low. Ideal for Roller shutter doors, Burglar alarms or counting metal objects passing by.

Were \$29.50 in August - NOW \$14.75 and they have not suffered from their dunking in the Derwent!!

## Jaycar

125 YORK St. "NEVILLE'S CORNER" Cnr CARLINGFORD & SYDNEY 2000

Phone: 264 6688

Telex: 72293

Mail Orders To: BOX K-39 HAYMARKET SYDNEY 2000

MINIMUM  
MAIL ORDER  
\$5.00



POST AND PACKING CHARGES  
\$5-\$9.99 (\$1.20) \$10-\$24.99 (\$2.40)  
\$25-\$49.99 (\$3.50) \$50-\$99.99 (\$4.60)

\$100 up (\$6.20)

NEW SHOP HOURS  
Mon 8.30 to 5.30pm  
Sat 8.30 to 12.00pm  
Thurs night to 8.30pm

## Walter Cronkite to address cable and subscription TV symposium

All aspects of introducing cable and subscription television to Australia are to be discussed at a major symposium. Former CBS anchorman, Walter Cronkite, will address the symposium as the keynote speaker.

**The symposium, sponsored by the recently formed Australian Cable and Subscription Communications Association, will be held at the Lakeside Hotel in Canberra on November 8 and 9.**

The Executive Director of ACASCA, Mr. Dick Rowe, said Mr. Cronkite had agreed to travel to Australia especially to address the symposium.

Other speakers would include: • Lord Hunt of Tanworth, who heads a crucial British Government committee inquiring into a recommendation from the Cabinet Information Technology Panel that cable services in the United Kingdom be immediately expanded

• The Minister for Communications, the Hon. N.A. Brown  
• The Chairman of the Australian Broadcasting Tribunal, Mr. David Jones, who headed the inquiry which in August recommended that cable and subscription television be introduced to Australia as soon as possible  
• Mr. David Jull, the Chairman of the Government Backbench committee on communications.

Mr. Rowe said further invitations to top level speakers were

currently in progress.

"In structuring the programme, we have been conscious of the need for issues to be discussed as broadly as possible because cable and subscription television will make wide ranging changes in Australia's media, the business community, education and various arts. We do not believe the nature of these changes is adequately understood by all sectors of the community which will benefit from them," said Mr. Rowe.

"As well as being ACASCA's first convention, the symposium is also the first public forum at which all the issues will be covered."

Mr. Rowe said strong interest in the event had already been expressed by business leaders, politicians, consumer groups, sociologists, educationists, the entertainment and media industries, academics, investors, electronics companies and industrial relations experts.

For further information please contact Mr. Dick Rowe, Richard J. Rowe and Associates, 2/225 Miller St, North Sydney 2060. P.O. Box 268, Spit Junction NSW 2088. (02)438-4814, 438-4815.

### New faces at ETI

**Jennifer Whyte,  
Assistant Editor**

Jennifer grew up on a farm in Western Australia. She received a Chemistry set for Christmas at age 12 and proceeded to experiment in the family kitchen. The production of some malodorous concoctions had her banished to the fruit packing shed. There she threw the results of her 'experiments' out the window into the paddock. This brought about a series of drastic events — killing the grass, giving the chooks constipation and the cows acidic milk. That's when she gave up chemistry. Playing with a wind-up gramophone and an old crystal radio, her thoughts naturally turned to electronics.

Growing up in the great outdoors provided a never-ending fund of questions, but not all the answers were available. Jennifer found out about sowing seeds, roosters and hens and artificial insemination and decided to study science.

Attending a girls-only boarding school in Perth taught her about living behind bars, falling in love with your science teacher (the only male brave enough to enter the school grounds) and going to church twice on Sundays.

Undaunted by this cloistered experience, Jennifer tackled university next, doing a Bachelor of Applied Science at the Western Australian Institute of Technology, majoring in Physics, men and all-night parties. Electronics was a major unit in the course and her father still uses the arc welder she built as a project. Boolean algebra and flip-flops appealed but she never did appreciate Schrodinger's equation explaining the behaviour of an electron in a one-dimensional box (too much like girls-only boarding school). She says she was spellbound by Einstein's theories, but that could have been a hangover.

While studying, she spent four months at the Carnarvon NASA tracking station, tracking satellites and kangaroos, doing some computer programming and sailing.

Jennifer's first job was teaching maths at a girls-only school, but that was 'a bit too close to home'. After a year she



joined the Medical Physics department at Royal Perth Hospital where she stayed for three years calibrating linear accelerators, cobalt machines and attending operations where radioactive sealed sources were implanted. Part time she studied anatomy, human physiology and oncology. Whilst there she rode a bicycle everywhere and learned Scuba diving.

Caught by the wanderbug, she left the hospital and travelled south-east Asia, India, England and Europe for a year. Returning to Australia, Jennifer settled in Sydney where she spent the past two years working for the Radiation Branch of the Health Commission. Jennifer collected samples from all over NSW for radiation analysis, wrote several articles for Hobby Electronics and started producing a monthly newsletter for a Scuba diving club. As she wanted to write and produce a magazine, Jennifer leapt at the chance to join ETI. Whilst she will be involved with the whole magazine, Jennifer will concentrate on the Electronic Lifestyle section.

Star sign: Aries.  
Beliefs: herself, magic, sea nymphs and ESP.

Likes: circuits that work, rain forests, the sun, sailing, Scuba diving, elephants, music and dancing.

Dislikes: eating meat, bagpipes, junk food, beer guts, hi-fi salesmen, old blue Mazdas, poseurs, Sydney traffic and wearing shoes.

Quote: "Einstein said, 'everything should be made as simple as possible', so why complicate things?"

(Next month: Geoff Nicholls, engineer extraordinaire. Well, engineer anyway.)

### Powerful guarantee

**Scientific Electronics are giving a five year guarantee on all their power supplies.**

This covers repairs on a no-charge basis (other than freight) on all power supplies manufactured by Scientific Electronics.

For further information contact Mr. Peter Lloyd, Scientific Electronics, 6 Holloway Drive, Bayswater Vic. 3153. (03)762-5777.

## World's fastest IC

Workers at Thomson-CSF's Central Research Laboratory in France claim they have developed the world's fastest IC for room temperature (25°C) operation.

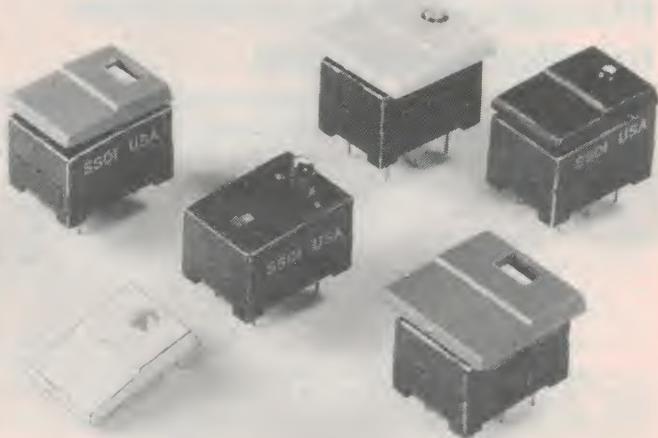
It is an eleven-stage ring oscillator with a gate delay time of 22 picoseconds ( $10^{-12}$  s)!

The device has a GaAlAs/GaAs structure which confines electrons at its heterojunctions. It was fabricated by a molecular beam epitaxial process capable of controlling crystal growth to 0.4 nm — which is about the thickness of a single atomic layer. Electron beam lithography was used to define the 0.6  $\mu$ m

gate lengths.

Thomson-CSF officials believe that their new technology will lead to shorter gate delay times than those currently achieved with circuits operating at very low temperatures. Indeed, circuits built with this new technology are expected to compete with Josephson effect devices for speed of operation.

Brian Dance



## 'Zippertubing'

Zippertubing offers a complete line of flexible, zip-on protective jacketing to bundle, insulate, protect, waterproof, assemble, shield, enclose, mark and identify wires, cables and other products.

Zippertubing is made from a wide variety of the latest plastic and allied materials designed to meet specific temperatures (high or low), abrasion, insulation, shielding (RFI, EMI, MF and HF system), chemical resistance, grounded or other special requirements.

Zippertubing features simple wrap-around quick-zip characteristics, and provides faster, easier and less expensive protection and covering than any other comparable method, the makers claim.

The closure device is a plastic zipper-track designed to give maximum flexibility without permanent sealing. It allows reworkability, modifications, repairs or additions by simply unzipping and rezipping for the entire life of the installation, or the zipper-track can be sealed permanently with ZT sealer. This chemically fuses the track and provides water-tight protection.

Zippertubing is available in various colours for colour coding, and has the additional advantage of harmonising the installations to equipment or plant. Zippertubing can also be supplied in many sizes and special configurations to meet specific needs.

Contact Adimex, 80 Jeffrey Drive, Ringwood Vic. 3134. (03)690-3233.



## Solid state pushbutton switches

C & K Electronics has introduced a new concept in logic-compatible pushbutton switches in their solid state pushbutton series 'SS01'.

The products offers self-contained electronics, logic-compatible circuit, multi-mode operation (user-selectable — momentary or maintained), bounce-free outputs, wide supply voltage range 3-16 V complementary outputs — 8 mA min. 'source' — 20 mA min. 'sink', DIP pin compatible, built-in status LED (internally connected), variety of snap-on cap configurations and eight colours, round or rectangular LED and three colours, plus insert-moulded pc terminals.

The SS01 is a complete electronic pushbutton module featuring a custom-design integrated circuit triggered by mechanical switching contacts. The contact interface is not critical to switch performance. A single jumper change in the external circuit determines the mode of operation — momentary or alternate action.

For further information contact C & K Electronics, 15 Cowper Street, Parramatta NSW 2150. (02)635-0799.

## Coline CRO probe kit

An oscilloscope probe kit, manufactured by the UK firm of Coline, is available from Elmeasco.

The probe provides switchable x1 and x10 attenuation, the probe-mounted switch also providing an 'input grounded' position which isolates the incoming signal and grounds the CRO input to permit adjusting the trace baseline.

On the x1 position, Coline claim the probe has a bandwidth of dc to 10 MHz, a 1 M input resistance and an input capacitance of 40 pF (+ CRO input capacitance). Working voltage is quoted as 600 volts (dc and peak ac).

On the x10 position, Coline

specify a dc to 100 MHz bandwidth, 3.5 ns risetime, 10 M input resistance and 11.5 pF input capacitance (with 30 pF CRO input capacitance). Compensation range is given as 10-60 pF and working voltage 600 V (dc and ac peak).

The kit includes an insulating tip, sprung hook tip, trimmer tool, IC adaptor, BNC adaptor and a carry pouch. Cable length is 1.5 metres. Cost is \$25 plus sales tax.

Enquiries to Elmeasco, P.O. Box 30, Concord NSW 2137. (02)736-2888.

## Elastomeric interconnections for microprocessors

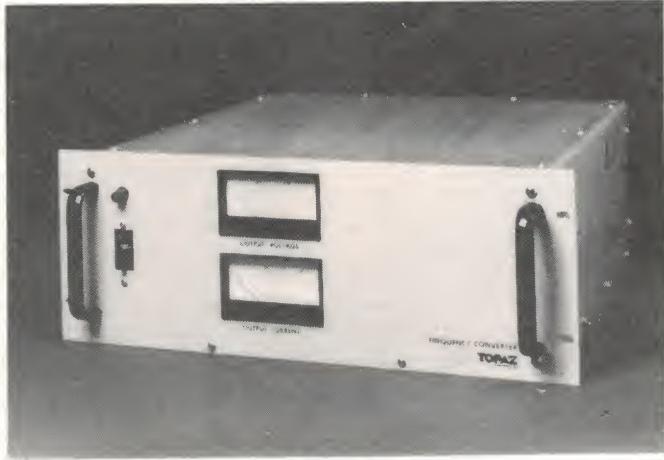
A metal-to-metal elastomeric connector system from Britain permits parallel or perpendicular planes of microprocessor circuitry to be reliably connected by pressure without any form of soldering or bonding.

'Cambiflex' from Cambion Electronic Products uses a non-conducting elastomeric core with parallel lines of gold-plated copper conductors on a thin film. When compressed between two parallel planes, the metallised lines interconnect the circuitry on each plane and provide multiple contacts. The elastomeric core produces the force for a reliable connection and serves as a resilient backing. This increases the contact area when under compression, accommodating surface irregularities and making correct contact resistance, the makers claim.

The 500 nm layer of gold provides an oxide-free surface and the standard circuitry pattern comprises 100 um lines on 0.2 mm centres.

The system is suitable for a wide range of interconnections. It can be used to make a connector for flat, flexible cable, independent of conductor spacing and accepting cable with conductors of 1.27 mm and 2.54 mm pitch.

The Australian agent for Cambion Electronic Products Ltd is Electronic Development Sales Pty Ltd, 92 Chandos Street, St. Leonards NSW 2065.



## Frequency conversion with voltage regulation

Topaz International has recently introduced its Series Z frequency converters, designed to convert the frequency of available ac power to a fixed output of 50 Hz, 60 Hz or 400 Hz.

Series Z converters provide frequency stability, output voltage regulation and noise isolation. Standard models reduce input voltage variations as large as +8% or -13% of nominal to an output level of plus or minus 1% of nominal. Direct one-to-one voltage conversion is provided for 115 Vac or 230 Vac inputs.

They are available in power

ratings ranging from 200 VA to 2 kVA. All models feature overload and short-circuit protection, automatic/manual restart selection and low harmonic distortion.

For more information contact Warburton Franki Ltd, 372 Eastern Valley Way, Chatswood NSW 2067. (02)407-3261.



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## High speed A-D converters

RIFA, Australian distributors for Precision Monolithics Inc, recently announced details of the DAC-08 8-bit monolithic digital-to-analogue converter, which provides very high-speed performance at low cost.

The DAC-08 is claimed to achieve 85 ns settling times with very low 'glitching' and at low power consumption.

Monotonic multiplying performance is attained over a 40:1 reference and full scale current eliminates the need for full scale trimming in most applications.

Direct interface to all popular logic families with full noise immunity is provided by the high swing, adjustable threshold logic inputs.

High voltage compliance dual-complementary current outputs are provided, increasing

versatility and enabling differential operation to effectively double the peak-to-peak output swing.

In many applications, the outputs can be directly converted to voltage without the need for an external op-amp.

Device performance is essentially unchanged over the ±4.5 to ±18 V power supply range, with 33 mW power consumption attainable with ±5 V supplies.

For further information, contact RIFA Pty Ltd, 202 Bell Street, Preston Vic. 3072. (03)480-1300.

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# NEWS digest

## NOTES & ERRATA

**ETI-644 Direct-connect modem**; October '82. Note that R93 should be rated at 1 W or 1.6 W (e.g. Philips PR37 resistor). Capacitor C5 (in reference channel flip-flop, IC5) can be reduced to 680p to provide a better variation range for RV1 ('adjust output symmetry pot'). Also note that C18 connects to pin 3 of IC12a on the pc board, not pin 2 as shown in the circuit.

In the Parts List, transistors Q4, 6, 8 & 10 were cut off — they are all BC549s. C4 is shown as 1n, but 1n2 on the circuit — it can be either. C19 should be a 2n2 and C21 a 330p. R48 should be 6k8, not 68k. Resistors R53 to R64 are given as 10k in the Parts List and 47k on the circuit. Either is correct.

**ETI-686 PPI-based EPROM programmer**; October '82. In the power supply circuit at the bottom of page 72 the A-E-N on the 240 Vac input should be A-N-E. Q1 is missing from the Parts List. It is a BC547.

**Inertial Navigation Systems**; September '82. Pages 16-17 have been transposed with pages 18-19. From page 14, the article reads on to page 18, from page 19 it reads on to page 16, from page 17 it reads on to page 20.

**Beating the RS232 Blues**; August '82. Figure 3 on page 85 shows the STOP and PARITY bits transposed. The parity bit comes before the stop bit. The associated text is correct.

**ETI-469 Percussion synthesiser**; April '82. Diodes D1 to D6 were omitted from the Parts List on page 43. They are all 1N914s or 1N4148s.

## Clock/oscillator modules

Bright Star Crystals have available a range of clock modules suitable for a wide range of clock and counter applications.

The BSC.BR module is a CMOS baud rate clock that can provide baud rate outputs from 300 to 9600. Stability is given as better than 10 ppm over an operating temperature range of 0 to 60°C. Supply required is between 5 and 12 Vdc.

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For further details, contact Bright Star Crystals Pty Ltd, 35 Eileen Rd, Clayton Vic. 3169. (03)546-5076.

## Industrial angular position sensors

Penny and Giles Potentiometers Ltd have introduced a new angular position sensor designed for use in severe rugged industrial environments.

Two models are available, both with potentiometric outputs. One incorporates the well-known hybrid technology for use in voltage divider modes and the other a wirewound track for use in variable resistance applications.

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100 x 10<sup>6</sup> cycles.

Penny and Giles are represented in Australia by Paton Electrical Pty Ltd, P.O. Box 363, Ashfield NSW 2131. (02)797-9222.



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Overall we are very impressed with the Blue Label System 80. On a dollar per function basis it probably represents the best value around for a ready-built computer. Other systems can be bought for less, but ultimately they are not as readily expandable as the System 80. There is also the matter of software, and here the System 80 really scores, with hundreds of compatible programs available for the TRS-80 as well as those specially written for the System 80. Reprinted with kind permission from ELECTRONICS AUSTRALIA June 1982

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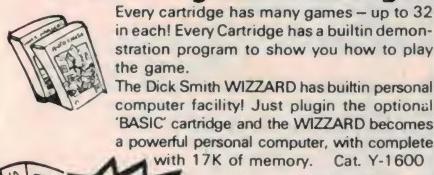
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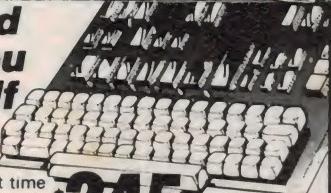
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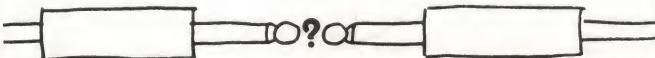
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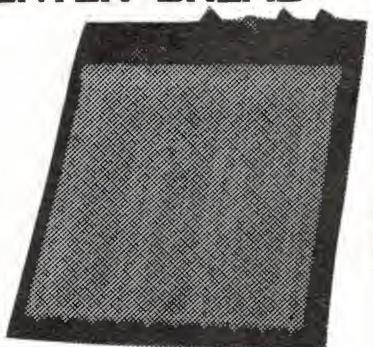
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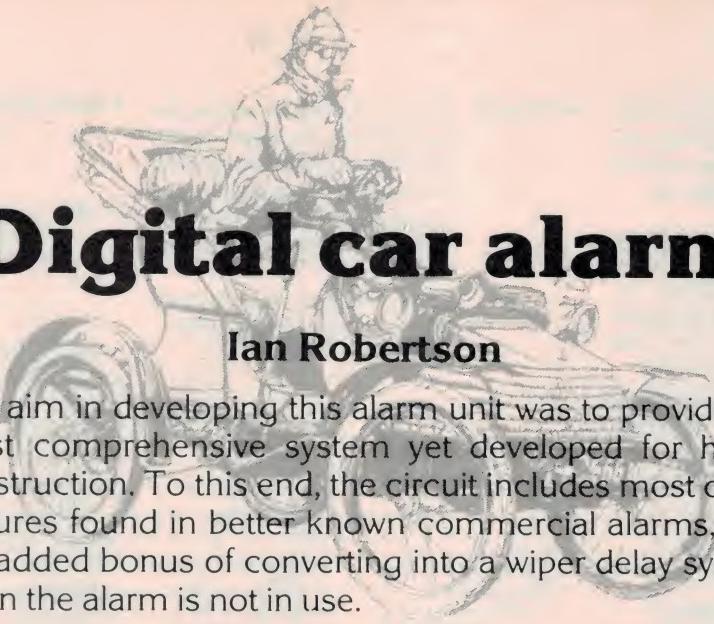
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# Digital car alarm

Ian Robertson

The aim in developing this alarm unit was to provide the most comprehensive system yet developed for home construction. To this end, the circuit includes most of the features found in better known commercial alarms, with the added bonus of converting into a wiper delay system when the alarm is not in use.

A MAJOR DIFFERENCE between this and other alarm circuits is the use of digital rather than analogue methods. The circuit uses a master oscillator feeding a divider chain to obtain the many time delays needed. Indeed the arrangement is in many ways similar to an electronic organ circuit.

An advantage of the digital technique is that all the delays maintain a fixed ratio to one another. They do not vary, as an analogue circuit will, due to component tolerance, leakage, temperature, etc and, by adjusting a single potentiometer in the master oscillator, all timing functions can be varied simultaneously. This means it is sufficient to check the accuracy of a single delay period to have, in effect, checked the accuracy of all delay periods. Further, by running the oscillator at, say, ten times normal frequency, a complete test that would normally take two minutes, will take under fifteen seconds.

With any alarm of this complexity the time and skill needed to carry out the installation within the car should not be underestimated. Fortunately there are a number of optional features in the system, and even if these are not used, the alarm will still be very effective. This gives each constructor the means whereby he can make the initial installation as simple or as complex as he wishes, while retaining the option of fitting the missing items at a later date.

## Features

The following is a list of the main features in the system. Each item gives only a brief description. Greater detail will be found elsewhere in the text.

### Flashing indicator

In operation whenever the alarm is set. Intended to deter a potential burglar, the indicator also reminds the owner to disable the system upon entering the car.

### Battery detector

Sensitive to the drop in voltage occurring whenever the load on the electrical system changes. Normally opening a door, operating the brake, switching the headlights on, or a number of similar actions, will trip the detector.

### Two delayed trigger inputs

Used in addition to (or in place of) the battery detector. These inputs are particularly useful in cars equipped with electric clocks, where the battery detector cannot always be successfully used. Suitable trigger inputs are the roof light, boot, bonnet and glove box lights. However, these must be powered from a circuit that remains energised at all times, even when the ignition is switched off.

### Four instantaneous trigger inputs

These are suitable for the protection of driving lights, cassette player, radio, etc. In use a wire is clamped under one of the mounting bolts of the item to be protected. Should this wire become detached from the chassis, as it will if the protected item is removed, the horn will sound immediately.

### Hidden switch option

Normally the alarm is cancelled by operating the ignition switch, however with this extra switch in circuit, a thief must locate both switches before he can cancel the alarm. The hidden switch will also prevent children, or curious adults, setting the alarm while the car is parked.

### Alarm relay

The alarm section is fitted with a two pole relay. One contact set is used to operate the horn while the other contacts may be used to flash the headlights or disable the ignition circuit or perhaps operate a second horn installed in the boot. It helps to have a second line

of defence should the horn be faulty or disconnected.

### Alarm timing

- Time to exit vehicle: 15 seconds
- Time to enter vehicle: 15 seconds
- Duration of horn: 96 seconds
- Horn pulse rate: one second on, one second off
- Indicator pulse rate: half second on, half second off.

### Wiper option

Whenever the alarm is not in use, the circuit converts into a wiper control unit. The output from this section is once again via a relay, it has a single changeover contact and will suit most wiper systems.

### Wiper timing

The wiper control switch settings are:

- Continuous wipe (CW), normal slow speed wiper operation
- Single wipe (SW), single operation every 2, 4, 8, 16, 32 or 64 seconds.
- Multiple wipe (MW), dual operation every 8, 16, 32 or 64 seconds.

### Operation

The heart of the alarm is an eight stage binary counter (ICs B & C) clocked by a 1 Hz master oscillator. By this means a delay of 256 seconds will occur whenever the counter is taken from zero count to maximum count. Shorter delays are available by using the various outputs, Q1 through Q8. In fact, any delay between one second and 256 seconds can be obtained by suitably decoding the 'Q' outputs.

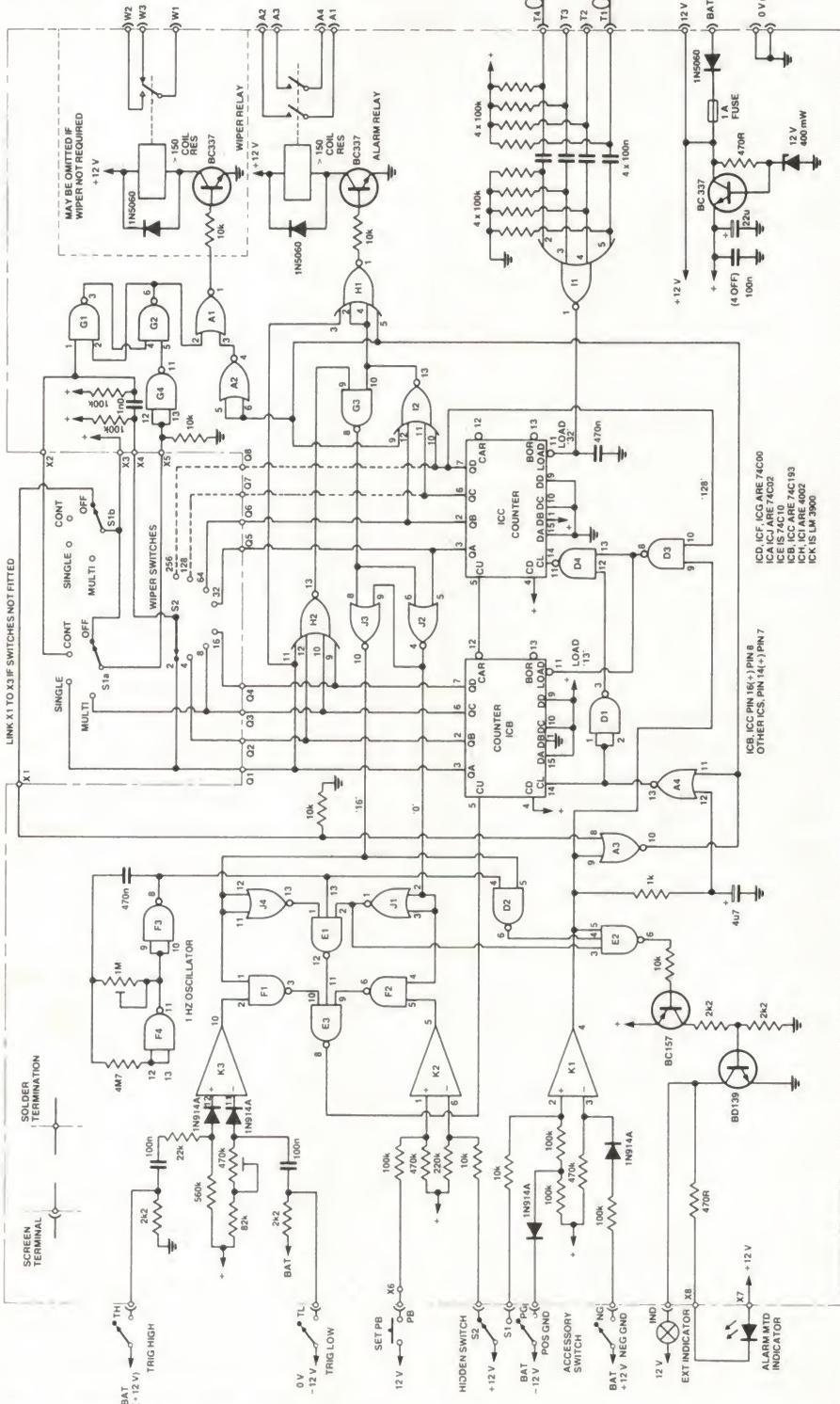
Below is a list of the outputs that have been decoded and also their main functions:

- **Zero** Interrupts the clock pulses, freezes the counter, holds the indicator off. Pressing the set pushbutton advances the counter.

- 1 to 15 Time allowed to leave the car without triggering the alarm. During this period the indicator remains on.

- 16 Interrupts the clock pulses, freezes the counter, flashes the indicator. Counter restarted by a signal from the battery detector or the delayed trigger inputs.

Circuit of the car alarm system. The dashed line indicates the electronics located in the diecast box I used to house the unit.



- 17 to 31 Time allowed to enter the car without the horn sounding. The alarm may be reset to zero by operating the ignition switch (also the hidden switch should this be fitted).

The indicator will remain on for any count greater than 16.

- 32 to 127 Alarm relay operates, pulsing the horn at one second intervals.

- 128 Returns the count to 16 where it may be retriggered should further interference to the car be detected.

In addition to the above, if at any time one of the instantaneous trigger inputs becomes detached from the chassis, the counter will set to 32 and the sequence will begin with the horn sounding immediately.

Similarly, any interruption to the power supply will set the counter to 32. This item is included to prevent cancelling of the alarm by simply removing the battery lead for a few seconds.

The conversion of the circuit from an alarm to a wiper system is under the control of the car ignition circuit:

- With the ignition and hidden switches OFF the alarm is activated, the wiper disabled
- With the ignition and hidden switches ON the wiper is activated, the alarm disabled. Or more simply, the alarm is enabled when the car is not in use, the wiper when the car is in use.

The basic requirement of any wiper control system is to pulse the wiper motor for approximately one second, then follow with a delay (variable) before the next one-second pulse. The length of the pulse is not critical, once the wiper has started to move the normal parking contacts will take over and complete the wipe cycle. Should the pulse be longer than required for a single wipe of the screen then more than one wipe will occur, and this is the method used to obtain dual wipes in the multi-wipe switch setting.

This circuit operates by allowing the counter to free run, while feeding the signal from a Q output (selected for the delay required) via a one-second pulsing network to the wiper relay. This gives a chain of one-second pulses separated by a switched delay interval. The pulse is extended to four seconds in the multi-wipe setting.

## Circuit description

Readers should refer to the various logic and circuit diagrams to clarify points raised in the following description.

All system timing is developed around the eight stage binary counter (ICs B & C). Two 74C193 up/down counters are used. However, in this circuit the down-count facility is not used. This proved to be the simplest way to obtain asynchronous load and clear inputs. Other counters I considered either lacked these inputs or they were of the synchronous type.

The counters are clocked by the 1 Hz master oscillator (ICs F3 & F4). This is a standard CMOS two-gate squarewave oscillator where the frequency can be adjusted over a wide range by the 500k preset.

Selective decoding of the counter outputs is carried out by the gates shown above the counter (main circuit); decoded are 0, 16, 32 and 128.

Normally the counter will free run unless the clock pulses are interrupted by gates E1 & E3, and this will occur at counts 0 and 16. If the count is stopped at zero it may be restarted by a pulse from the set push button, if stopped at 16 may be restarted by a pulse from the battery detector, trigger high or trigger low inputs.

Any counter greater than 32 will operate the horn via the horn relay and gate H1. Note also that gate H1, and therefore the horn, is pulsed on and off by output Q1 on counter B.

Various gates below ICs C and B are used to clear and load the counters. These inputs, as mentioned earlier, are synchronous and may be operated at any time, even during periods when the clock is halted. The way these inputs have been used needs explanation.

Turning the ignition on resets both counters, and this in turn interrupts the clock and holds the alarm in the standby position.

A signal from one of the four instantaneous trigger inputs will set the counter. In this instance a count of  $\geq 32$  will be loaded, causing the horn to sound, and continue to sound, while the counter steps through to 128. In a similar manner, the capacitor on the load terminal of C will force the output to  $\geq 32$  for each power up of the circuit.

Reaching a count of 128 resets the counters to 13 which involves clearing counter C while loading 13 into counter B. Loading 13 will silence the horn while giving three counts for the electrical system to settle before the battery detector is rearmed at a count of 16.

Most input signals are buffered by the LM3900 quad op-amp. Keep in mind that this device compares input currents whereas the conventional op-amp compares input voltages. Using resistors to convert voltages to currents, standard operational amplifier circuitry can be realised, but note when testing that both inputs are clamped to within 0.5 V of negative by the base-emitter junction of the input transistors.

Nonetheless, the circuit operation is straightforward with K1 handling the accessory switch inputs (positive or negative ground systems), K2 buffers the set push button, while the hidden switch feeds both K1 and K2. The low value (10k) resistors used in the switch circuit can override any other input signal and will prevent the alarm being

set in position S2 or cancelled in position S1.

A short RC delay network is fitted in one line from the output of K1, which resets the counters each time the accessory switch is turned off, thereby ensuring the alarm sequence will start from zero and overcome a problem that occurs if the ignition is switched off with the wiper running.

Section K3 functions as the battery drop detector while also functioning as the trigger high/low input buffer. Figure 10 shows the battery detector in a simpler form. Both inputs are fed from a common voltage, but the lower value resistor feeding the inverter input drives the output low.

If a negative pulse occurs on the battery line it will be coupled into the inverting input by the 100n capacitor. This will reverse-bias the inverting input resulting in the op-amp output going high and developing a pulse to advance the counter one count. In the final circuit a diode is included in series with the op-amp input, this means the diode and not the inverting input is driven negative, and prevents possible damage to the IC.

Delayed trigger inputs TL and TH operate in a similar fashion. Note that in this instance the TL input feeds a negative pulse into the inverting input while the TH input is somewhat different as it feeds a positive pulse into the non-inverting input. The result however, is the same — a positive pulse at the output of K3.

The instantaneous trigger inputs (T1 and T4) are quite different. Normally, the four inputs are held at earth potential so that, should any input be detached, a pulse will enter the NOR gate via the appropriate RC network. A negative-going pulse occurs at the output of the gate, loading 32 into the counter, thereby enabling the horn sequence. Unused inputs can in practice be left floating, as they respond to the change in voltage not the voltage level.

An important feature is the indicating light. This may be a LED or lamp and is operated by a two transistor driver stage, under the control of gate E2. The indicator may be off, illuminated or flashing and the sequence is as follows:

- Off when wiper operation selected
- Off for standby mode, counter zero
- Flashing when armed, count of 16
- Illuminated for all other counts.

The ICs are supplied via a series pass transistor and the function on this stage is not primarily as a regulator. The intention is to limit the voltage fed to the ICs to below the rated maximum of 15 V. In order to limit dissipation in the series transistor a 12 V zener is used. This means that the transistor is hard on with a nominal 12 V rail and will not start to regulate until the input voltage

is some volts above this value.

Conversion into a wiper control unit requires that the counters free run, and to obtain this the load and clear inputs must be overridden and the gates decoding 0 and 16 must be blocked. This is under the control of the ignition switch. A logic '0' on the output of K1 sets the circuit as a wiper control and a logic '1' at this point sets the alarm function.

The free-running counter will give a squarewave signal from the various 'Q' outputs. The period in seconds given at each stage is two at Q1, four at Q2, eight at Q3, extending through to 256 at Q8. By means of an RS flip-flop (cross-coupled gates, G1 and G2) the squarewaves are converted into an asymmetrical wave having one second ON periods and switch-selectable OFF periods.

Diagram 12 shows Q3 with a period of eight seconds setting the RS flip-flop, while the inversion of Q1 resets the same flip-flop every two seconds. The resulting output, one second on seven seconds off, is clearly shown.

On the multiple wipe setting the flip-flop is reset by the inversion of Q3, not Q1, and this will give a pulse four seconds long in lieu of the previous one-second pulse. Depending on the speed of individual wiper motors two or three wipes will occur during this period.

## Construction

Construction is fairly straightforward, however there are two forms this may take. The first is to build only the alarm, the second is to built the alarm/wiper combination. There are points for and against either approach and these are covered in the installation notes. In the construction there is little difference between systems, although in units without the wiper option, one relay, two switches and a couple of minor components can be omitted.

(Note that this article is not intended as an ETI constructional project and thus no pc board details are given.)

## Testing

A completed unit should operate with a minimum of adjustment, however I recommend setting up the test circuit (Figure 9) to check out the alarm before fitting it into the car.

Simple faults may be located with a multimeter, but for more elusive faults an oscilloscope will be required.

The 12 V for testing may be obtained from the car's own battery, in situ, or more conveniently from a battery on the work bench. Alternatively a bench power supply may be used with the restriction that it may not test the battery detector circuit in all respects.

Steps for testing using Figure 9 are:

- Set preset potentiometers to approximately mid-way

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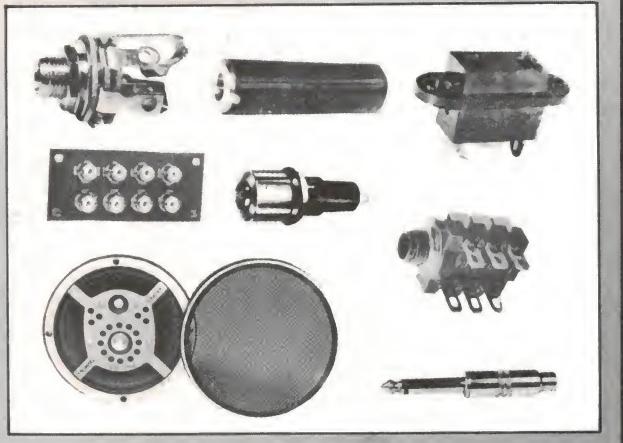
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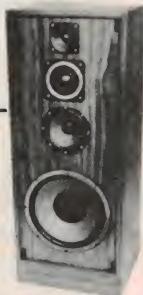
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- With the power and accessory switches on, all other switches off, check that the indicator light, alarm relay and wiper relay are all off
- Move the wiper switch to continuous wipe (CW) and the wiper relay will pick up and remain up
- Move to the single wipe position (SW) and the relay will pulse at an interval determined by the second wiper switch. By adjustment of the 1M oscillator preset, the interval can be matched to the times marked on the switch. Reducing the resistance of the preset too far (frequency increasing) will stop the oscillator
- The multiple wipe setting (MW) is similar to the single wipe setting, however the relay pulse will be longer (four seconds) and switch settings 2 and 4 will give the same timing as position 8
- Turn the wiper and accessory switches off and the indicator, alarm relay and wiper relay should be off
- Momentarily operate the push button. This will set the alarm, and light the indicator for a period of 15 s (exit time)
- After the exit time the indicator will flash at one second intervals showing the alarm is set
- The alarm may now be triggered by means of the battery detector, opening a car door if the car battery is being used, or with a bench supply momentarily reducing the voltage by about three volts. If a bench battery is being used, connect a load, say a 15 W lamp, across the battery terminals. For correct operation the 470k sensitivity preset may need adjustment as maximum sensitivity is obtained with maximum resistance in circuit. Slowly rotate the preset until the indicator latches on, back off 1 mm, reset circuit (using accessory switch and the push button) and then try again
- The 15 s entry delay will occur, followed by the horn relay pulsing at one second intervals for a period of just over one and a half minutes. The circuit will reset with the indicator flashing
- The alarm may also be triggered by either the TH or TL switch and these operate in the same manner as the battery detector
- At any point during the above sequence, closing the accessory switch should cancel the alarm, forcing the relay and indicator off
- Close the instantaneous trigger switch (T1). Reset the alarm using the accessory switch and push button. Opening switch T1 will cause the horn relay to operate, pulsing for the normal 1½ minute horn period
- Momentarily opening the power switch will also cause the horn relay to operate

- Other switches can be added for a more detailed test. Add the hidden switch, PG, T2, T3, T4 switches and with either an ohmmeter or lamp, check the alarm relay contacts, wiper relay contacts and also the indicator output.

## Installation

The alarm may be installed with or without the wiper components. The combined alarm/wiper system must be mounted within reach of the driver, and this can mean the unit is more accessible if the car is broken into. By foregoing the wiper control the electronics may be hidden, and by using extended leads, the push button and indicator may still be fitted in the dash. I, however, advise against mounting the wiper switches outside the alarm as the circuit could be effected by noise pulses introduced by the connecting cables.

Keep the wattage of the indicator down and use a high output LED or a low power lamp. Each time the indicator turns on it attempts to trip the battery detector. This in turn is set less sensitive, and if taken too far the system may not respond in an emergency. The roof light must be not less than four times the wattage of the indicator.

In mounting the alarm, each constructor must determine the most suitable position in his car.

Wiring should be carried out in stages, starting with the basic circuit (Figure 1 or Figure 2) followed by the optional items (Figure 3 to Figure 8). As each stage is fitted, the circuitry may be tested and the faults found. Testing stage by stage is possible with this alarm circuit because careful design has eliminated the need to bridge unused terminals to override the redundant function.

Care is required to select the correct horn circuit as this should match the existing wiring whilst also taking into account the current demand of the horn(s) to be driven. The wiring must suit the currents involved. As a guide the cables used for the relay contacts (also the 0 V and BAT circuits) should have approximately the same area as the horn wiring already fitted in your car. The remaining runs can be any standard hook-up wire and the size can be chosen for mechanical rather than electrical reasons.

During the alarm installation it is easy to overlook the part played by the wiring, for it is often the wiring and not the alarm that is most vulnerable. Take particular care to conceal the cable runs and to ensure all connections are sound and will not cause intermittent operation at a later date.

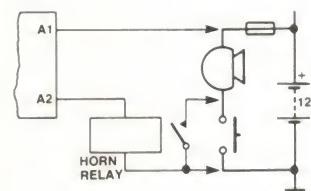
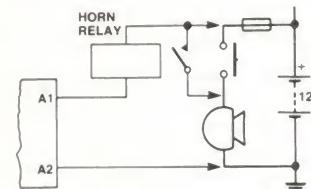
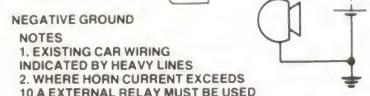
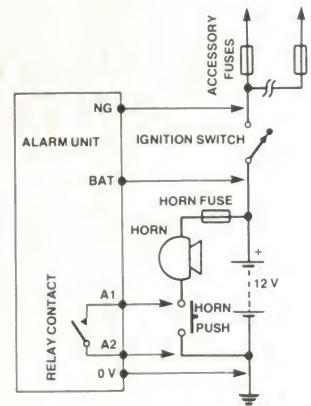


Figure 1. Basic alarm system, negative ground, with variations to the horn circuit.

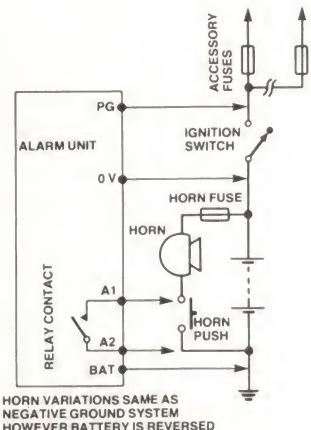


Figure 2. Basic alarm system, positive ground.

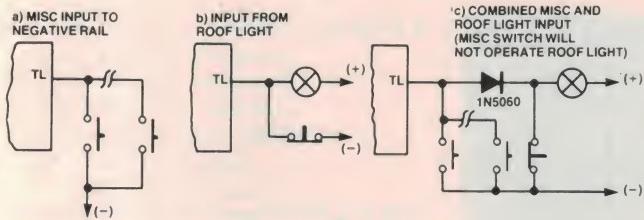


Figure 3. TL input: using added switches or roof light.

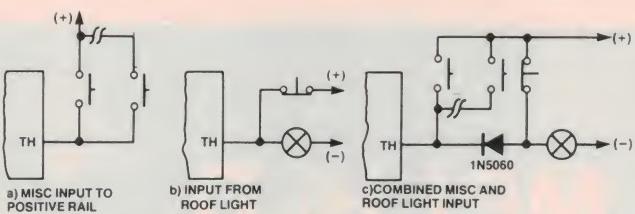


Figure 4. TH input: using added switches or existing roof light.

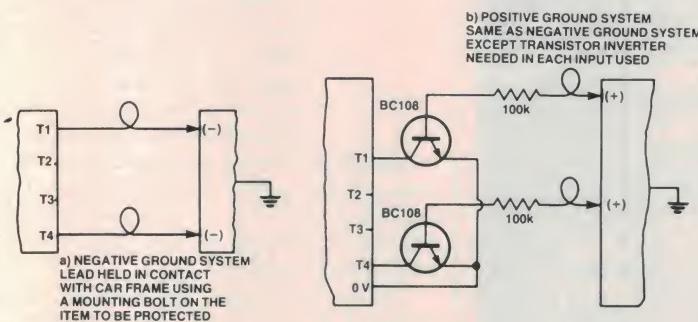


Figure 5. T1 to T4 inputs: for driving light and radio protector.

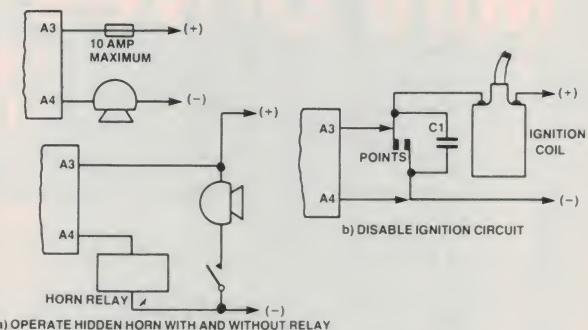


Figure 6. A3 and A4 alarm relay contact; giving extra protection.

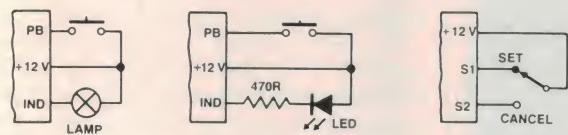


Figure 7. PB and IND terminals: external pushbutton and indicator.

Figure 8. Wiring a hidden switch.

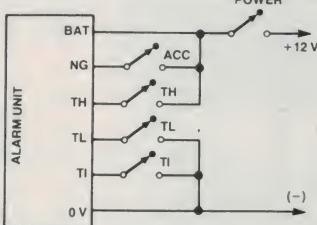


Figure 9. Basic test circuit.

Figure 10. Simplified battery-drop detector.

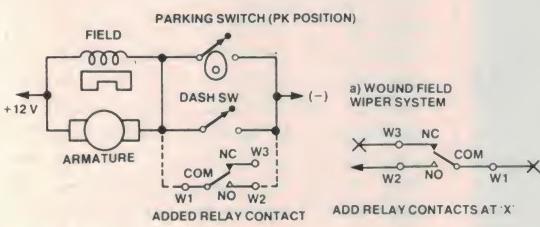


Figure 11. Wiper operation.

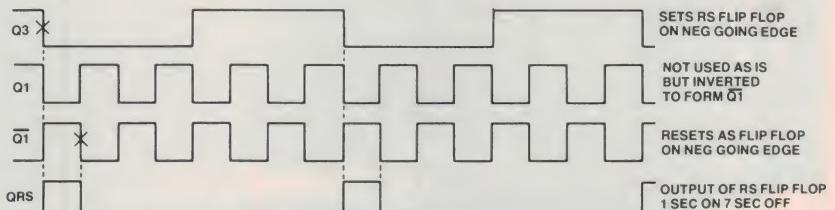


Figure 12. Wiper circuit timing diagram.

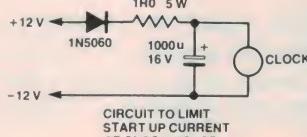


Figure 13. Clock circuit modification to prevent tripping of alarm.

Included are a number of diagrams and these show how to wire the optional features.

- **TH & TL** Delayed inputs for connection to the roof light circuit may also be fed from any number of additional points. Possible switch positions are rear doors, tail-gate or glovebox (Figure 3 & 4).

- **T1 to T4** Instantaneous inputs are clamped under driving lights, cassette, radio, etc and will sound the horn as soon as the connection is broken. A transistor inverter stage will be necessary in vehicles with a positive ground system, however this stage should only be

fitted to inputs that are actually used (Figure 5).

- **A3 & A4** Spare contacts on alarm relay may be used for a number of auxiliary functions. The contacts have a current limit of 10 A and larger currents require a horn or lamp relay to be fitted (Figure 6).

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- **S1 & S2** Hidden switch, normally concealed under the dash or front seat, must be in the set position to activate the alarm or the cancel position to deactivate the alarm (Figure 8).

- **W1 to W3** Wiper control relay contact with W1, W2, W3 corresponding to the common, normally open and normally closed relay contacts. This relay is suitable for the majority of wiper motors, the exception being a continuously variable system.

A number of wiper arrangements have been used over the years but these can be loosely divided into two categories, motors with wound fields or motors with permanent magnet fields.

The earliest type of motor employed a wound field, and these were characterised by a good self-braking action. All that is required for control is a simple on-off switch. Self parking is achieved by a mechanically linked parking switch which keeps power applied in all but the parking position (Figure 11a).

The more recent type of permanent magnet motor does not have the same braking characteristics, and it is necessary to apply dynamic braking by placing a short across the armature. Here a changeover self-parking contact is used which either applies power to the armature or places a short across it (Figure 11b). The added relay contact opens the brake circuit and then applies power to the armature low speed brush. (Dashboard switch is off.) Once the wipers are in motion the cam-operated contacts parallel the relay contacts, allowing the relay to be released and the wiper action to continue until one complete sweep has been made. Thus the wiper will give a single low speed stroke for each relay operation.

In vehicles fitted with an electrically driven clock there is a possibility of false alarms. This applies particularly to clocks that are rewound at intervals by a small motor.

Two general approaches may overcome this problem. Reduce the sensitivity of the battery detector or limit the starting current of the clock motor.

The sensitivity of the battery detector is adjusted by the 470k preset, while the start-up current can be reduced by the network shown in Figure 13. The component values are a guide only and in certain instances a series resistor may be found to be all that is required.

If all else fails the alarm may be triggered by the TH or TL inputs via the roof light circuit. Hopefully the battery detector can still be set to operate with the brake light or similar high current circuit.

# The Sparkrite 'Voyager' car computer



High technology on the highway. This 'third generation' car computer is a marvel of modern electronic engineering.

THE FIRST generation 'car computers' used a combination of analogue and digital circuit techniques to calculate and display various parameters of a vehicle's performance. Of major interest was fuel consumption — the result of rapid rises in the price of fuel. The 'real time' display of fuel consumption enables a driver to see the rate of consumption during various phases of driving — whilst accelerating, climbing hills, passing, changing gears etc. This sort of information is very handy for learning to drive 'economically'. Also of interest was performance over a trip — average fuel consumption over the distance travelled. Relative consumptions between 'city driving' and 'highway driving' can be compared.

The first generation of car computers gave these parameters and a few others. They were expensive and generally sold as an 'after market' item. But, they did a job and some motorists saw them as useful.

The second generation of car computers rapidly followed on the heels of the first. They incorporated microprocessors and featured a great many more functions, some of which were there 'because they could be easily incorporated'. These second generation units featured many more components than the earlier ones, in many instances, the use of a microprocessor notwithstanding. By this time, a car computer

became either an 'optional accessory' or part of a 'standard pack' on vehicles, as well as being an after market item. By this time, too, most motorists knew what a 'car computer' was.

The Sparkrite 'Voyager' car computer, designed and manufactured in Britain, represents the 'third generation' car computer. It is an after market unit, imported and sold in Australia by Jaycar Pty Ltd. The thing that makes this a third generation unit is the incorporation of a specially-designed and manufactured mask-programmed microprocessor, which is basically four computers in one. In addition, the latest in display technology is employed: a gas discharge vacuum fluorescent display tube with large, bright digits that can be readily seen under widely varying conditions of ambient light — very important in a motor vehicle. The traditional LED displays are always problematical in a vehicle. The result is a reduction in component count and thus a reduction in manufacturing cost, whilst still retaining all the previous features demanded and allowing the addition of new ones.

To provide input data for the computer, two sensors are required: a *fuel flow* sensor and a *distance* sensor. The fuel flow sensor is inserted in series with the fuel line to the carburettor. The fuel passes through an internal mechanism which spins a disc consist-

ing of alternate translucent and opaque sectors. On the outside casing of the sensor are mounted an LED, providing a light source, and a light-sensitive diode. The casing is translucent, allowing the internal disc to 'chop' the light beam transmitted through the casing, thus providing a series of pulses for the computer to work with. The spinning rate of the disc varies with varying fuel flow, providing a varying pulse rate to the computer from which rate of fuel consumption can be calculated.

The distance sensor requires magnets to be mounted on a drive shaft — the tail shaft on rear wheel drive vehicles, the drive shaft on front wheel drive vehicles. A magnetic pickup is located on the chassis adjacent to the drive shaft mounted magnets. As the drive shaft rotates, the magnets create varying currents in the pickup coil — a pulse for each pass of each magnet. These pulses will vary directly with speed of rotation of the drive shaft, enabling vehicle speed to be determined, and the number of pulses will be proportional to the distance travelled. Non-linearity in the sensors is compensated for in the microprocessor.

The computer in the Voyager contains a 'memory' enabling you to enter information on fuel, distance and time; the capacity being in excess of 3200 km (2000 ml) for distance, 820 litres of fuel (180 gal.) and 100 hours for time. ►

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There are three primary 'computing' modes. There's the LOG mode which can display average fuel consumption since setting the computer — with readout in imperial mpg, or litres per 100 km (to 0.1) or the new British standard of miles per litre (also to 0.1). The last would be of little interest here, but being able to get consumption (metric, l/100 km) or its inverse (imperial, mpg) is very handy. The LOG mode also gives you fuel used since setting the computer — to 0.05 gal., or 0.1 litres, and you can read out distance travelled since setting to 0.1 miles or km.

The NOW mode gives instantaneous readout of consumption from second to second as you drive, in mpg, l/100 km or miles per litre. This mode also gives a clock — time of day in hours and minutes in 12 hour format as well as providing a stopwatch. Great for rallying! In addition, the NOW mode provides instantaneous speed from second to second in kph or mph — and the readout is digital, don't forget, and reacts much faster than conventional speedometers.

The TRIP mode gives distance travelled since setting the computer, elapsed time (which stops automatically when you turn off the ignition) and average speed over the trip, computed continuously to 0.1 kph or mph.

In addition, several ALARM functions are provided — a very handy feature. You can set two speed alarms — providing a high-pitched note when you exceed a preprogrammed limit, a low note when you drop back below it. Actual speed is displayed as the alarm sounds. There is a time alarm, which acts just like an alarm clock, even when the ignition is turned off and there is a 'lights left on alarm' which sounds if you turn off the ignition and leave your lights on.

The display brightness is automatically controlled by a light sensor mounted behind the front panel, the brightness being increased or reduced according to the level of ambient light incident on the front panel of the unit. Very handy.

Construction-wise, the Voyager is very well engineered. It seems as much attention has been paid to the electronic engineering as to the mechanical. Also, it is clear a great deal of thought has gone into the ergonomic design. The unit is compact, has a logically laid out front panel with tactile-feel pushbuttons and a beeper which sounds when you operate any button. The front panel is of a 'sandwich' construction. The neutral brown background has the designations silk screened on top, each mode having the associated buttons grouped together and bracketed. The panel is lit from the rear by six parallel-connected filament lamps. The rear of the front panel is

clear perspex, with an intermediate translucent white section which disperses the light to evenly illuminate the front of the panel. The display is behind a red panel. The case front surround overhangs the front panel at the top, providing some shading. The case is only about 70 mm deep, inside of which mount two pc boards, sandwiched together immediately behind the front panel. Each board is fibreglass with double-sided tracks and plated-through holes. The board immediately behind the front panel contains the buttons, light sensor, lamps and a few sundry components. It has sockets which plug into the rear board which contains all the electronics and the fluorescent display. A piezoelectric beeper is mounted on the rear of this board. Clearly, top-quality components are used throughout, many from the European electronics giants, some Japanese. Overall, impressively designed and constructed.

Connection to the outside world is via a multipin connector, accessed from the rear of the case, to which a flat ribbon cable is attached via a plug.

The makers have thought of virtually everything in the way of attachments and connections for installing their Voyager car computer. The 'command module', as they call it, can be mounted on or under the dash, on the centre console, on the windscreen or a side window. Attachment hardware is extremely versatile. Installation instructions that come with the unit are clearly written and copiously illustrated. The same could be said of the operating instructions.

As soon as he saw the Voyager, Jonathan Scott wanted it. Now, Jonathan Scott likes 'things Italian': food, women and cars. He drives a Fiat X1-9. Problem. Where to put the Voyager. The X1-9 is compact, Jonathan is very tall. When he gets in wearing his shades, the only room left is on the passenger side dash. Problem. When the Italian lady 'passenger' gets in, certain parts of her anatomy would obscure the Voyager's display and randomly operate the buttons. Solution — get a more demure passenger. Jonathan is presently working on installing the Voyager and removing the stiletto heel scratches from the Fiat's bodywork. The scratches on his bodywork will heal themselves, in time.

No matter if you own a Fiat X1-9 or 1973 Holden Kingswood, if you want to know how your car performs, or keep an accurate log, then the Sparkrite Voyager is worth a hard look. At \$199, one wouldn't have to look too hard. Contact Jaycar Pty Ltd, 125 York St, Sydney or Cnr Carlingford and Pennant Hills Rds, Carlingford NSW.

# 5 CAR COMPUTERS TO WIN!

WOW! Five diligent, lucky, perseverant, persistent contestants will each receive a Sparkrite Voyager car computer, supplied by Jaycar.



Here's a chance to own a top line, high technology car computer of your own. JAYCAR has agreed to supply no less than five **Sparkrite VOYAGER** car computers as prizes for this simple to enter contest. All you have to do is answer these half-dozen questions, complete the coupon and send it to:

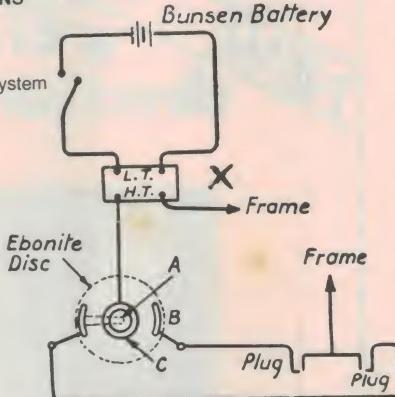
**ETI/JAYCAR CAR COMPUTER CONTEST**  
**ETI Magazine, 15 Boundary St**  
**RUCHCUTTERS BAY NSW 2011**

There's a bit of a challenge in answering the questions, so with a modicum of resourcefulness you stand a good chance of winning a car computer. Go to it!

**HOW TO ENTER.** All you have to do is answer the questions on the entry form, fill out the coupon and send the completed entry form to the address given above. Please read the rules **carefully**. Multiple entries will be accepted. You must enter your name and address on each entry submitted. Photostats or clearly written copies of the entry form will be accepted, but if sending copies you **must** cut out and include with **each entry form** the month and page number from the bottom of the page of the contest. When sending multiple entries, then, you will need extra copies of the magazine so that you send an original page number with each entry.

**ANSWER THESE SIX QUESTIONS**

- 1) What is this circuit?  
 A trembler coil ignition  
 The first battery/coil ignition system  
 An early electric fence



- 2) Who designed the circuit in question 1?  
 Davy  
 Clerk  
 Faraday  
 Kettering  
 Lenoir
- 3) Which mechanician designed the coil marked X in the circuit in question 1?  
 Runbaken  
 Lucas  
 Kettering  
 Lenoir  
 Ruhmkorff  
 Ruhmkrove

**RULES.** This contest is open to all persons normally resident within Australia with the exception of members of the staff of Jaycar Pty Ltd, Murray Publishers, Offset Alpine, Australian Consolidated Press and/or associated companies. Closing date for this contest is **31 December 1982**. Entries received within 7 days of the closing date will be accepted if postmarked prior to and including 31 December 1982. The winning entries will be drawn by the Editor of ETI whose decision will be final. No correspondence will be entered into regarding that decision.

Winners will be advised by telegram the same day the result is declared. The name of the winners, together with the winning answers, will be published in the next possible issue of ETI.

Contestants must enter their name and address where indicated on each entry form and include with each entry the month and page number from the bottom of the page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration, accompanying this contest, that they have read the above rules and agree to abide by their conditions.

You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand portion of the page containing the entry form. You must put your name and address on the entry form and sign it where indicated.

**CONTEST CLOSES 31 DECEMBER 1982**

- 4) How does this quotation end?  
 "A traveller without knowledge is . . ."  
 like a fish without a bicycle  
 a bird without wings

- 5) Who said the above?  
 Samuel Johnson  
 Richard Burton  
 Jack (walks-on-the-water) O'Donnell  
 Sa'di  
 Robert Louis Stevenson

- 6) Apart from computing everything you want to know about your car's performance, the Sparkrite Voyager provides three alarm functions. Describe one and, on a separate sheet of paper tell us, in less than 25 words, for what purpose you would use this feature.

Name .....  
 Address .....  
 Postcode .....

Send to: ETI/JAYCAR Car Computer Contest, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

I have read the rules of the contest and agree to abide by their conditions:

Signed .....

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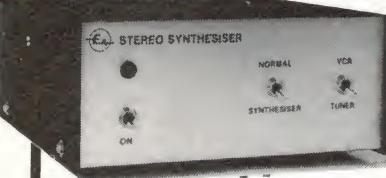
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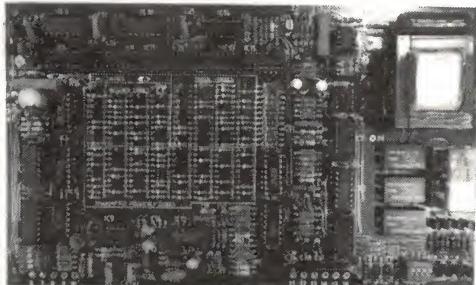
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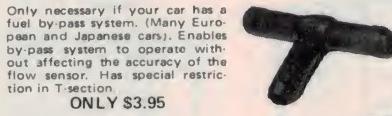
This device has been tested and endorsed by EA. It works on cars that don't have tailshafts!! We won't treat you like an imbecile and say not to buy it in case your speedo cable breaks - how often does THAT happen? At \$29.50 you may as well leave it in the car when you sell it, as it is cheaper than most speedo cables anyway.

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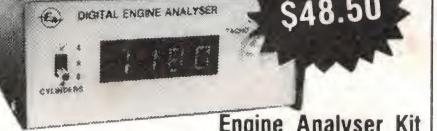
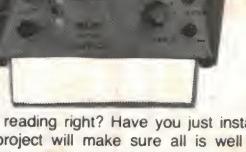
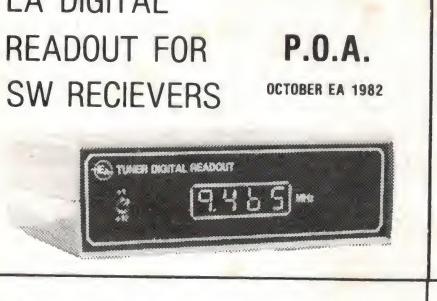
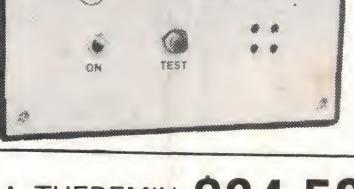
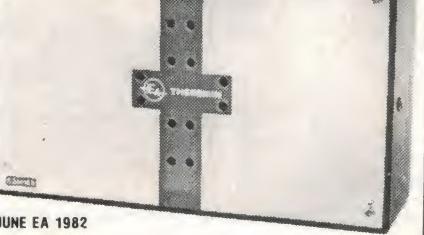


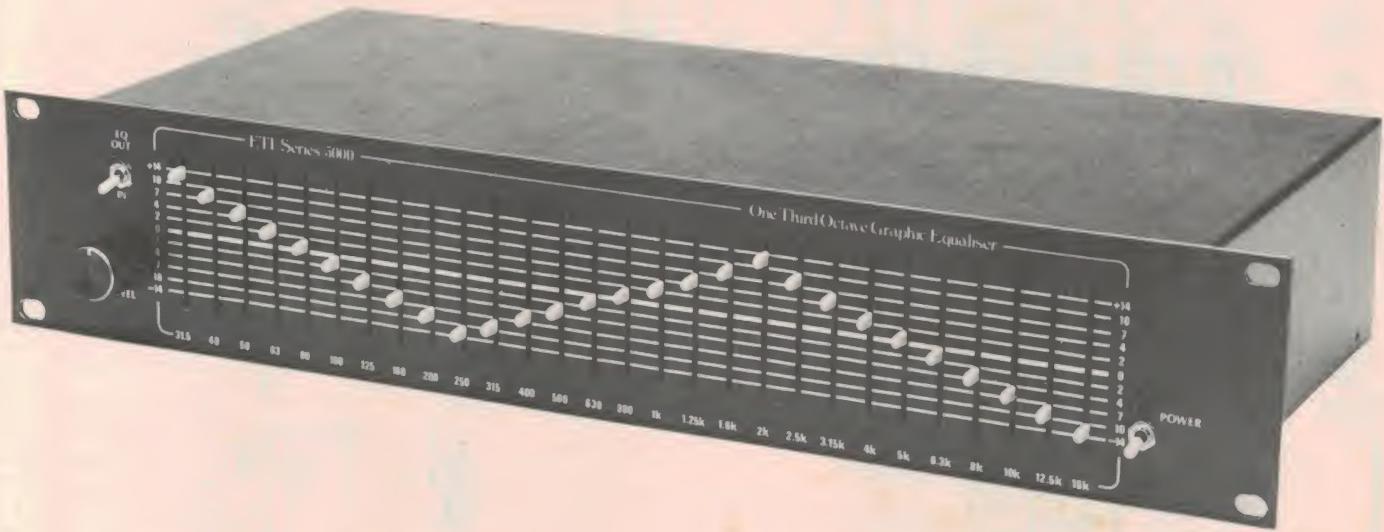
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## Series 5000 one-third octave graphic equaliser

Is your listening room/concert hall dull and lifeless? Or does it echo and ring with a multitude of sounds long after the last note has died away? If changing the environment is unacceptable or too expensive, then this graphic equaliser will likely effect a distinct improvement. For obvious mechanical reasons, this is a mono unit; two are required for stereo.

SINCE the Series 5000 preamplifier and power amplifier were published (during 1981) we have had many requests for this project. The inherent reliability and superlative performance of the MOSFET power stage makes the 5000 power amp ideally suited for use in professional applications. Unfortunately many of these applications are in difficult or 'problem' listening environments such as large halls or simply rooms with poor acoustic properties. Listening environments with too little damping lead to resonances and reverberation that can seriously degrade the intelligibility of music or speech. By contrast, rooms with too much damping lead to muffled and lifeless acoustic performance due to excessive attenuation of certain bands of the audio spectrum. To a certain extent these problems are unavoidable, at least with present technology. It is

impossible to completely cure a listening environment of inherent problems such as resonances or excessive reverberation. The latter phenomena can cause feedback resulting in oscillation of the sound system or 'howl round'. The problem is that the amplitude of an oscillation is not related in a simple way to the amount of excitation. The maximum amplitude is a function of several variables, one of which is the damping of the listening environment. This converts sound energy into heat and prevents it from being reflected back into the room to further excite the resonance. The time taken for the resonance or oscillation to reach its maximum is also a function of the excitation level, i.e. the volume at which the sound is being reproduced. Problems associated with overdamped listening environments are slightly easier to

correct, although a complete cure is again almost impossible, especially in bad cases.

The equipment used most often to correct faults in the listening environment is the one-third octave graphic equaliser. This divides the audio spectrum into roughly one-third octave intervals and allows effectively independent amplitude control over each of the frequency bands. We have published one-octave equalisers in the past, as a compromise between the full one-third octave design and the simple tone control system provided on most preamplifiers. These are not suitable however for professional applications which demand more control than is offered by these simpler units. To meet the demand for a full one-third octave equaliser we have designed the Series 5000 unit offering noise and distortion performance that will not ►

**David Tilbrook**

# Project 459

## third-octave graphic

seriously degrade the performance of such a high quality system. It should be noted however, that the use of any one-third octave equaliser will affect the performance of the system simply because it is in circuit. Each of the filters has a relatively high Q and will therefore cause significant modification to the overall phase linearity as well as the frequency response when cut or boost is applied. I have seen many otherwise high quality systems degraded significantly by the excessive use of one-third octave equalisers and we do not recommend the incorporation of these units into a high quality system unless a specific need is apparent. Nevertheless, when modification of the frequency response is required, no matter how drastic or how modest, a one-third octave graphic equaliser is an almost ideal way of doing this.

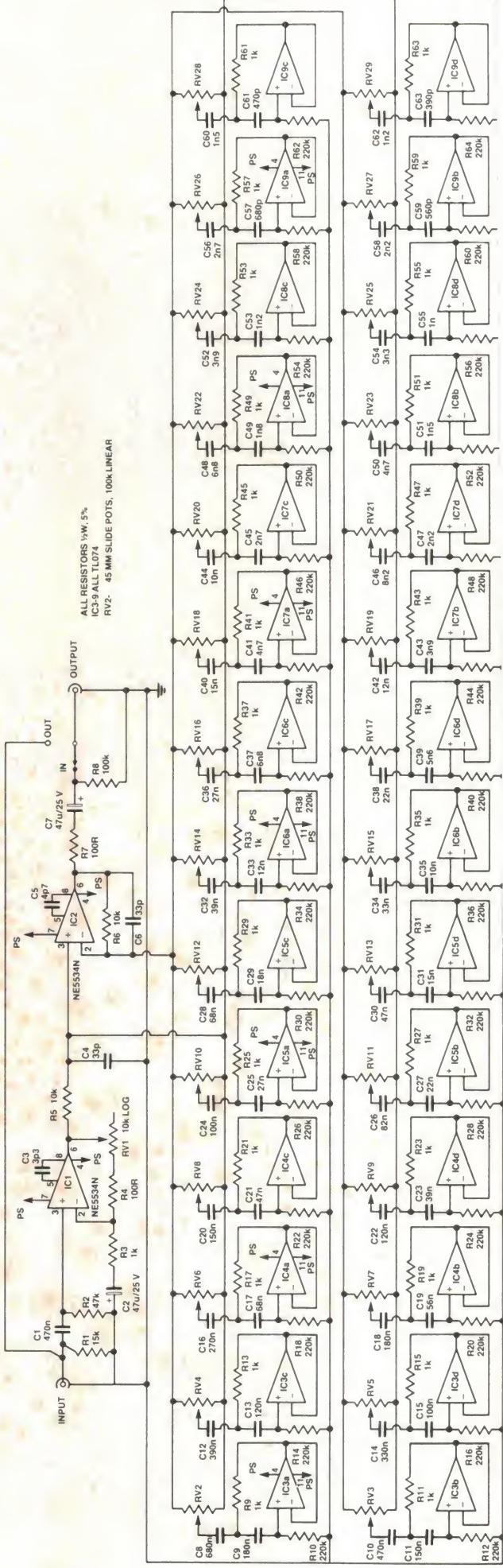
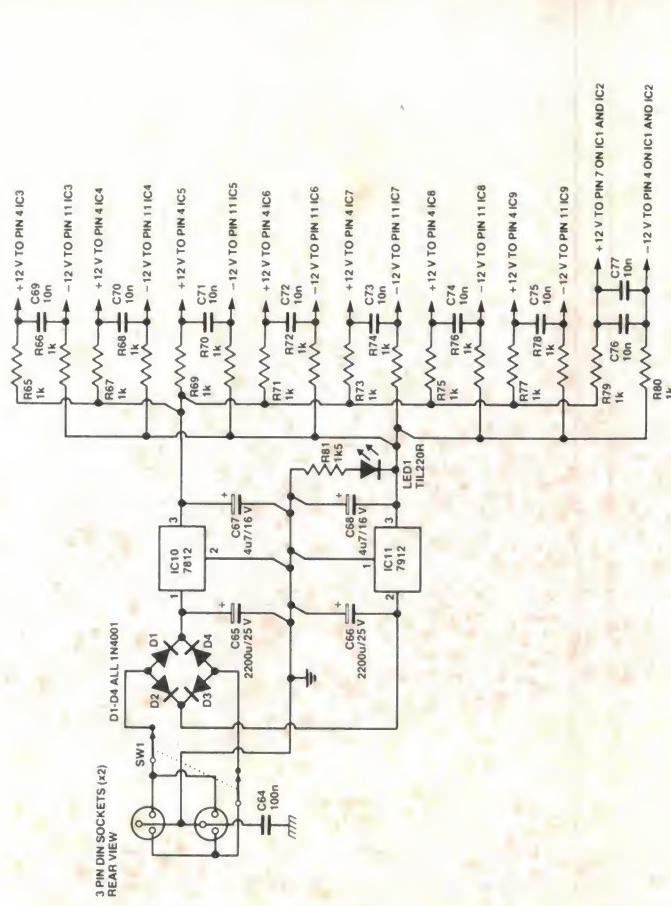
Each channel of the equaliser is controlled by a separate slide potentiometer so the array of pots gives an approximate indication of the response inserted

by the device. Further, the relative ease of operation ensures that setting up can be accomplished in a reasonable time.

### Design

The Series 5000 graphic is basically an extension of the principle used in the older ETI-485 one-octave stereo graphic equaliser. Each filter is formed by a series resonant network incorporated into the feedback loop of a high quality operational amplifier. In this case we have used the NE5534N, the same op-amp used in the Series 5000 pre-amplifier. The advantages of this device are covered in the series of articles describing that project (Sept.-Oct. 81).

'Gyrators' are used to simulate the inductors necessary for the series of band-pass filters so there are no coils to wind. The gyrator is covered in more detail in the How it Works section, but the main problem associated with this approach is caused by phase shifts occurring in the op-amps used in the gyrators. The basic principle of a gyrator is to invert the



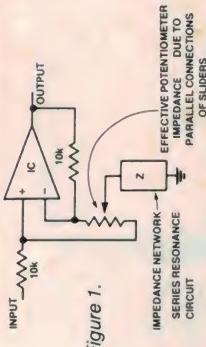


Figure 1.

In order to illustrate the principle of operation of the graphic equaliser we first need to consider the operation of a simplified version of a single stage, as illustrated in Figure 1. Here, the input signal is fed to the non-inverting input of an op-amp through a 10k resistor. A potentiometer is connected between the non-inverting and inverting inputs with its wiper going to signal common (ground) via a network represented by Z. Here, a series-resonant circuit is employed. Feedback is provided between the op-amp output and the inverting input. The input resistor forms a potential divider with part of the potentiometer (from the op-amp + input to the wiper) and the impedance Z to common. The feedback resistor also forms a potential divider with the end of the pot from the inverting input and the impedance Z to ground.

If the wiper of the pot is set to mid-travel, the attenuation of the input signal due to the potential divider is compensated by the gain of the op-amp and the overall gain from input to output is unity. If the pot wiper is now moved toward that end of the pot connected to the op-amp's inverting input, the gain of the stage is increased as the feedback ratio is reduced owing to a reduction of the impedance from the op-amp's inverting input to common. At the same time less attenuation of the input signal occurs as the impedance from the non-inverting input to common is decreased. The stage will have gain, maximum gain being determined by the impedance of the series resonant network. If this is low, gain will be high. Series resonant networks exhibit very low impedance at resonance, rising either side of that frequency.

When the wiper of the pot is moved toward the non-inverting input of the op-amp, the attenuation due to the input potential divider is increased. The gain of the op-amp is decreased at the same time as the feedback ratio is increased because the impedance from the inverting input to common is increased. Once again, the overall gain of the circuit is a function of the impedance of the series resonant circuit, but this time the gain is at a minimum — in fact, attenuation occurs.

By choosing a suitable Q for the series resonant network, the bandwidth can be set to cover a desired frequency range. The potentiometer then sets gain or attenuation of the stage at the centre of the chosen frequency band.

The technique just described above can be used whenever it is desired to incorporate a relatively large number of filters into the signal path as in graphic equalisers or tone controls. The filter networks need not be bandpass or notch filters, simpler bass and treble controls can also be used.

Once this basic configuration is set up, all that remains is to design the filter networks. As mentioned before, series resonant networks were used since these give the required characteristic of low impedance at the resonant frequency. In their simplest form these networks consist of an inductor, capacitor and resistor in series. At the resonant frequency, the impedance of the circuit is equal to that of the resistor assuming a perfect inductor and capacitor were used. To eliminate the inductor an op-amp circuit has been used to simulate the characteristics of an inductor. Such a circuit is called a 'gyrator'.

The gyrator circuit can provide both the inductance and the series resistance required in the network so this can simply be placed in series with the capacitor to form the required resonant circuit. This is shown in block diagram form in Figure 2.

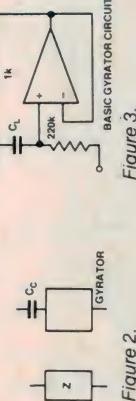


Figure 2.

Figure 3 shows the general circuit of the gyrator used in this project. The amount of inductance generated by this circuit is given by the simple equation:

$$L = 1k \times 220k \times Cc \text{ in Henries}$$

where the value of Cc is in Farads

The equivalent circuit of the gyrator is shown in Figure 4. The series resistance is equal to the 1k resistor while the 220k resistor becomes the parallel resistance of the coil. This value is high enough not to affect circuit operation drastically. The resonant frequency of this filter is given by the standard formula:

$$F = \frac{1}{2 \sqrt{LC}}$$

The general circuit, simplified, of the Series 5000 third-octave graphic equaliser is shown in Figure 5. IC1 is simply a variable gain stage which also provides some input buffering. IC2 is the filter stage with group of 28 gyrator circuits, all connected in parallel, in the feedback circuit. Commencing at a centre frequency of 31.5 Hz, each gyrator filter has a Q chosen such that its bandwidth covers one-third of an octave. Thus the upper and lower the 3 dB points of adjacent filters 'touch'. A total of 28 filters are required to cover the audio frequency band. Filters are not placed

on the band limits of 20 Hz and 20 kHz as they are not really required. To reduce the IC count a set of seven quad op-amps (TL074s or uA774s) are used for the gyrators. Slide pots are used to set the gain or attenuation inserted for each third-octave band as it is easy to see, at a glance, how much gain or attenuation has been set and, as all the pots are lined up in parallel across the front panel, one can instantly see the total modification made to the audio system's frequency response.

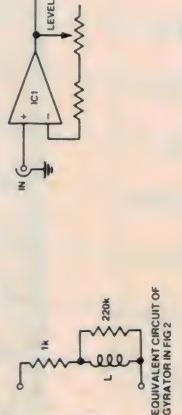


Figure 4.

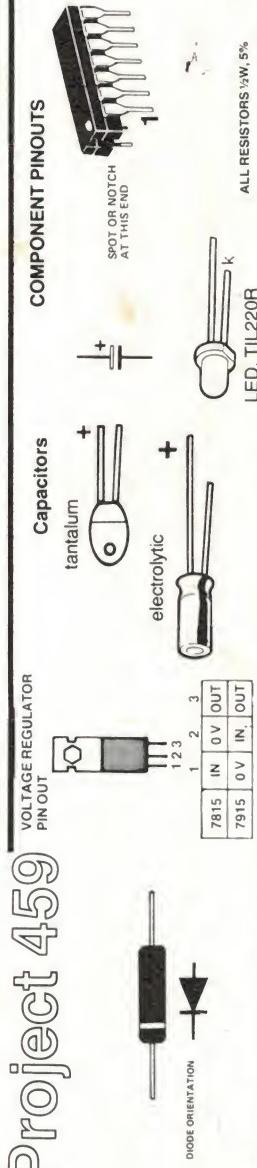
Figure 5. Simplified diagram of the equaliser.

## Construction

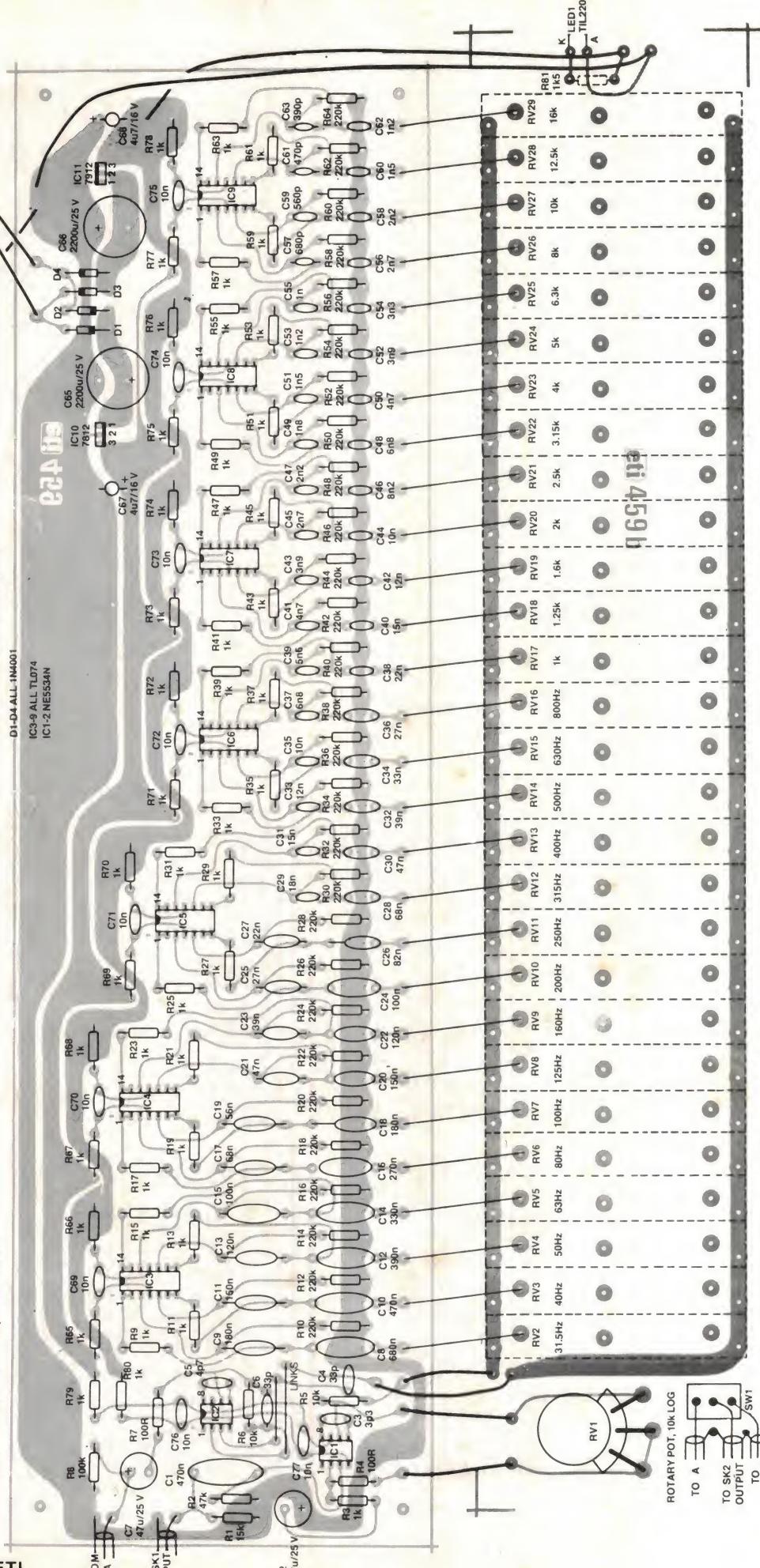
The one-third octave equaliser divides the audio frequency band into 28 segments so a total of 28 slide pots are used. Cutting the required slots in a front panel is an extremely difficult task so this is one project that is probably best built from one of the kits, supplied by various outlets, which incorporate a pre-punched chassis and front panel. For those with the necessary equipment to construct their own chassis we have supplied detailed drawings of the metalwork required. Assuming that the project is constructed from a kit, most of the work is restricted to assembling two pc boards. One of these holds the bulk of the components while the other holds the slide pots and the 'power on' LED and its associated current limiting resistor. ▲

Project 459

## third-octave graphic



This board viewed from component side.



This board viewed from copper side.

Resistors	all 1/2W, 5%
R1,5,6	15k
R2	47k
R3,9,11,13,15,17,	
19,21,23,25,27,29,	
31,33,35,37,39,41,	
43,45,47,49,51,53,	
55,57,59,61,63,	
65-80	1k
R4	100R
R7	100R
R8	100k
R10,12,14,16,18,20,	
22,24,26,28,30,32,	
34,36,38,40,42,44,	
46,48,50,52,54,56,	
58,60,62,64	.220k
R81	1k5
RV1	rotary pot, 10k log
RV2-29	.45 mm slide pots, 100k or 50k linear.

Construction of the main pc board is not difficult. The usual precautions should be taken with the orientation of all polarised components such as electrolytic capacitors, transistors, diodes and ICs. Note that the two voltage regulator ICs are not mounted in the same direction. Check the component overlay for the correct orientation. It is probably wise to leave the insertion of the quad op-amps until last since these are FET devices and are therefore more sensitive to static electricity than the other components in the unit. Be careful when handling these devices before insertion on the board. Use an earthed soldering iron and discharge yourself by touching an earthed metal appliance before handling the ICs. The inputs are protected and should therefore be reasonably safe from damage by static electricity.

Construction of the second pc board is not difficult either, although some care should be taken to ensure that the slide pots are mounted so that their shafts are as close as possible to forming a right angle with the pc board. Probably the easiest way to do this is to first solder one pin of the slide pot and adjust the position of the slider while heating the joint with a soldering iron. When the position is satisfactory, solder the remaining pins and proceed to the next slider. The single resistor can be

soldered on at this stage but I found it easier to leave the mounting of the LED until after the pc board is attached to the front chassis. Mount the RCA sockets on the rear panel. Note that these sockets are insulated from the chassis. The same technique is used for this as was used in the Series 5000 preamplifier. First insert a rubber washer of the appropriate inside diameter into the holes drilled in the rear panel, then mount the sockets. A photograph has been included with the construction details to illustrate this.

The chassis of the unit is not connected directly to the power supply earth. A 100n capacitor is soldered between the 0 V point on the power supply DIN sockets and the chassis to provide RF shielding to the rest of the circuitry but no dc connection should be used. This is consistent with the earthing principle of the entire Series 5000 range of components and is a good general principle to adopt to ensure freedom from earth loops. If you are constructing the unit for operation in systems not including a Series 5000 power amplifier you will need a small transformer to supply the necessary 30 V centre-tapped ac supply. There is sufficient room to allow mounting of the transformer on the back panel above the centre section of the pc board. When using a transformer inside the chassis

Capacitors	
C1,10	.470n
C2,7	.47u/25 V RB electro
C3	363 NPO ceramic
C4,6	339 NPO ceramic
C5	407 NPO ceramic
C8	.680n
C9,18	180n
C11,20	150n
C12	390n
C13,22	120n
C14	330n
C15,24,64	.100n
C16	270n
C17,28	.68n
C19	56n
C21,30	.47n
C23,32	.39n
C25,36	.27n
C26	.82n
C27,38	.22n

Semiconductors	
IC1,IC2	NE5534N
IC3,4,5-9	TL074
IC10	7812
IC11	7912
D1-D4	1N4001
LED1	TIL220R

#### Miscellaneous

ETI-459 a & b pc boards; SW1 — DPST toggle switch; chassis and panel as per drawings; two 3-pin DIN sockets; knobs for slide pots; SW2 — SPDT toggle switch; nuts, bolts, wire, etc.

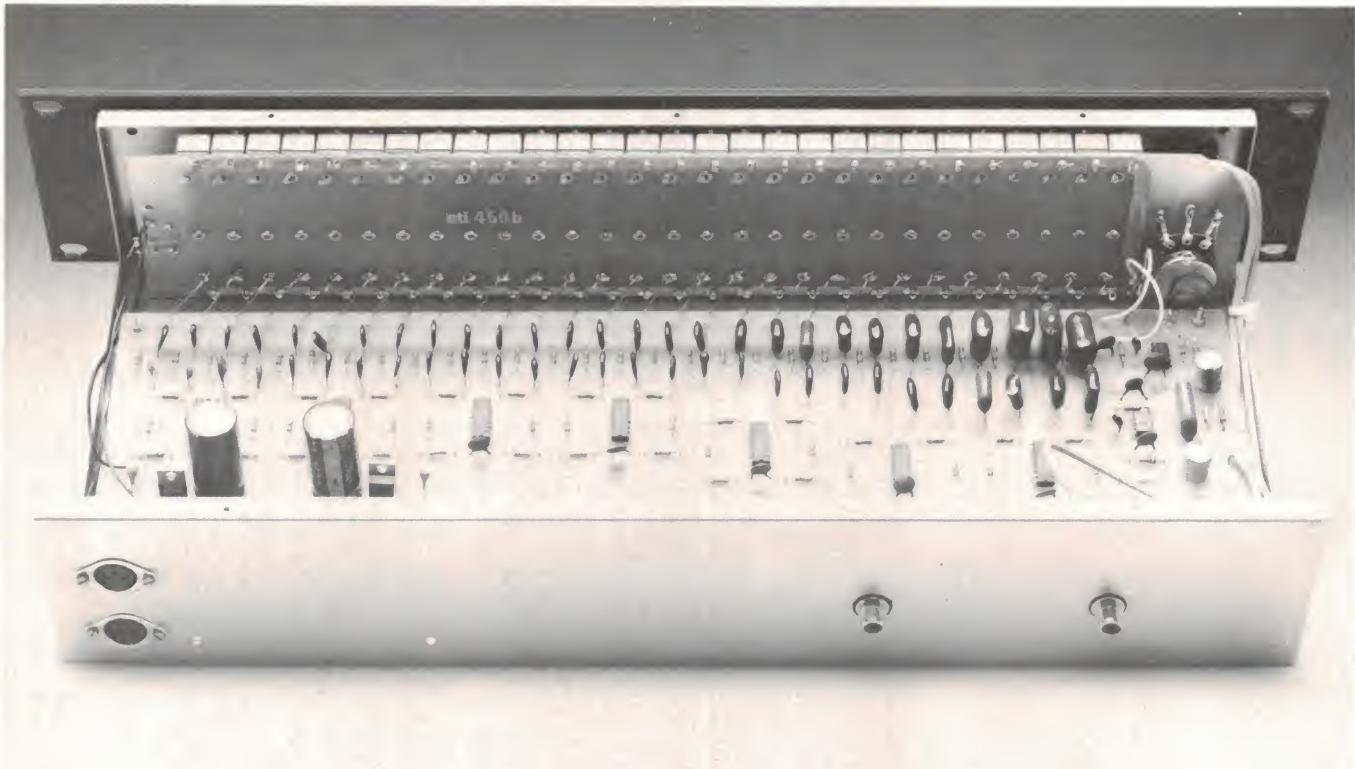
**Price estimate \$200 — \$220**

the switch and use this as a tag point. Now solder four wires to the power switch. Two of these must go to the rear panel and the other two to the power input points on the main pc board. Check the construction diagrams if in doubt about these connections.

The slide pot pc board is secured to the front panel by eight bolts that are screwed directly into eight of the slide pots. Countersunk bolts are used and the heads of these bolts are concealed by the front panel. The two switches should first be placed in their respective holes and secured by nuts to the front of the chassis. These nuts must be removed later when fitting the front panel but are used at this stage to hold the switches in place while the front pc board is mounted.

The easiest way to mount this pc board is to pass all of the bolts through the chassis front securing them in place with a small piece of adhesive tape placed across the front on the head. Slide brass spacers over the bolts, tightening the chassis up if necessary to keep these from sliding off the bolts. Now position the pc board in place, passing the slide pot shafts through their respective slots. One at a time the pieces of tape can be removed and the bolt screwed into the slide pots. Mount the main pc board on spacers and carry out the necessary inter-

# Project 459



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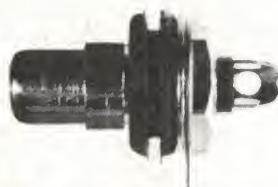
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connections using the flying leads already secured to the board.

Finally, mount the front panel to the chassis. First remove the switch nuts. Secure the front panel with four 2 BA nuts and bolts. Use a washer between the front panel and the switch nuts when securing the switches to the front panel. This helps prevent the possibility of scratching the front panel when tightening the nuts. Push a LED mounting washer through the front panel. The LED can now be mounted. Be careful to insert the LED the correct way around.



The RCA sockets mount through the hole of rubber grommets fixed to the rear panel, electrically isolating them from the panel.

Place the leads through the pc board and then push the LED into the washer from behind. You may have to bend the leads a little to get them into the holes in the pc board. Finally, solder leads. All that remains is to secure the cover. Use self tappers passed through the cover into the main chassis. Since the pots are mounted on half inch (12.5 mm)

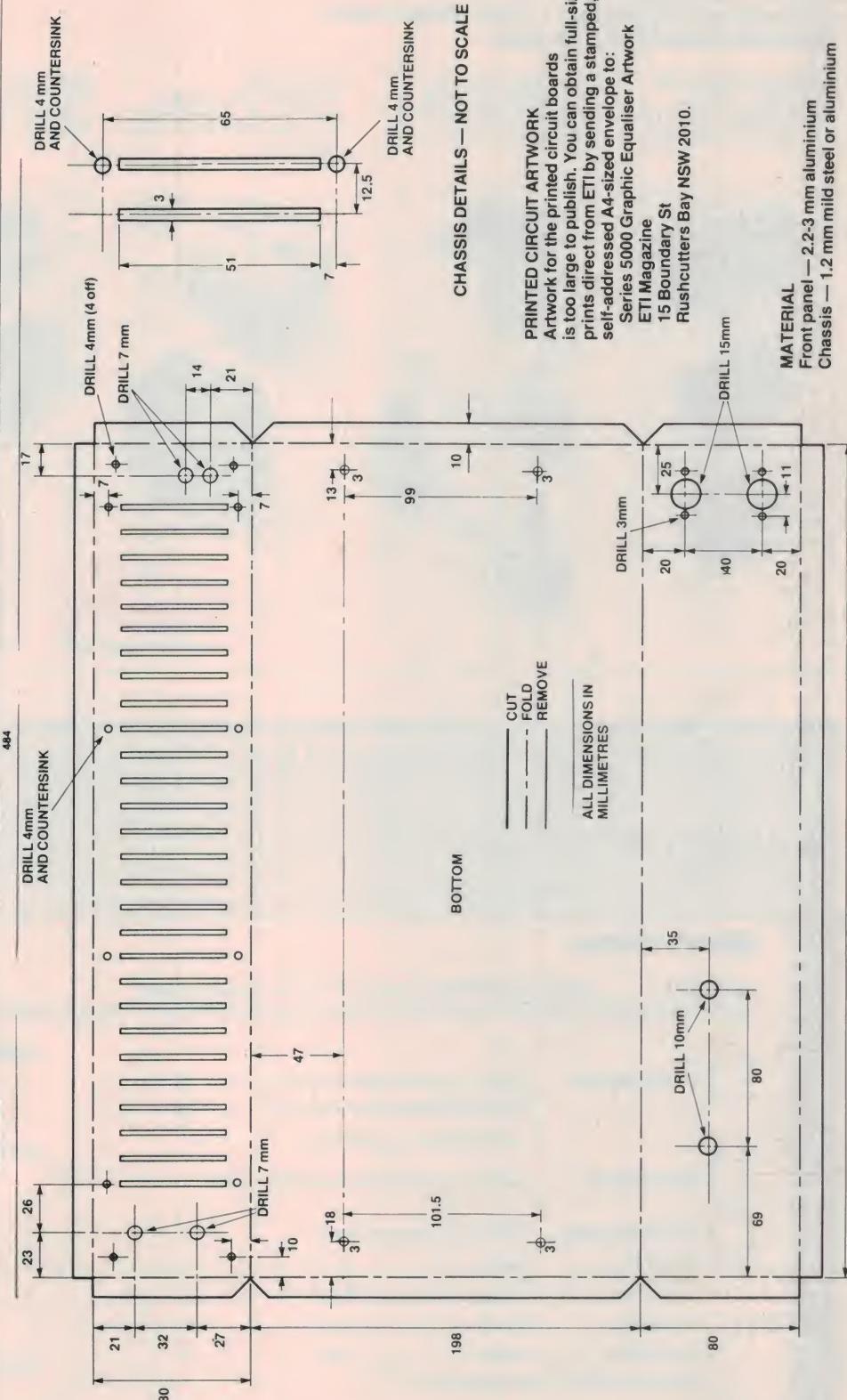
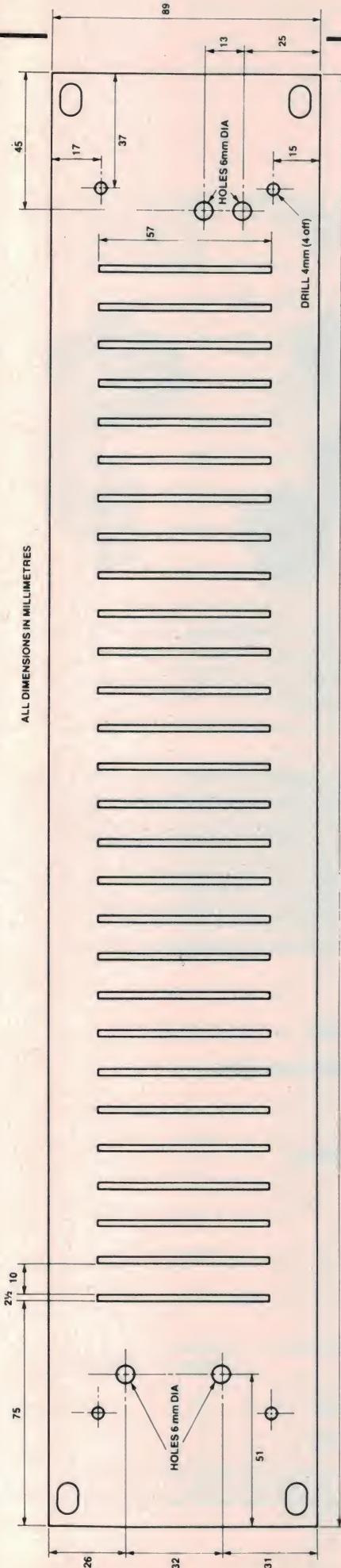
spacings there is not enough room for the usual slide pot knobs. We used small rubber covers supplied originally for use with small toggle switches. These are very common and are available in a variety of colours.

## Power up

Once construction is complete check all power supply wiring before powering up. This is especially important if a transformer has been included inside the chassis. In the latter case, make certain all 240 V connections are secure and check the chassis earth. If all is correct, power the unit up. The LED should light to indicate that the unit is on.

An equaliser in/out switch has been provided to ensure that a flat response can be obtained easily and without the necessity of changing the equalisation that may have taken some time to set up. The equaliser is intended for use immediately before the power amplifier. If used in this position the level control will probably not be used. In this case turn the control fully *counterclockwise*. The overall gain of the equaliser with the controls set at centre will be approximately unity. If the equaliser is intended for use from a typical line level output, the gain control can be used to supply the output levels needed by the power amplifier input.

third-octave graphic



ETI November 1982 - 37

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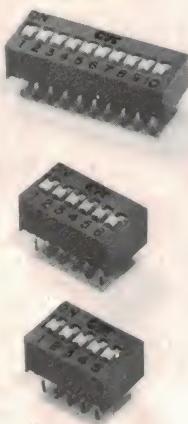
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6XMV5053S

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STETTNER 3.12 pf	Normal Price	Special Price
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ELECTROLYTICS		
2.2Mfd 25V RB s	16c	80c
10Mfd 16V RB s	16c	80c
10Mfd 25V RB s	16c	80c
25Mfd 25V RB s	17c	85c
47Mfd 16V	20c	\$1.00
47Mfd 25V RB s	22c	\$1.10
100Mfd 10V RB s	20c	\$1.00
100Mfd 25V RB s	26c	\$1.30
220Mfd 25V RB s	36c	\$1.80

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.001Mfd 100V Greencaps	8c	40c
.0047Mfd 100V Greencaps	8c	40c
.01Mfd 100V Greencaps	14c	70c
.012Mfd 100V Greencaps	14c	70c
.022Mfd 100V Greencaps	14c	70c
.033Mfd 100V Greencaps	14c	70c
.039Mfd 100V Greencaps	14c	70c
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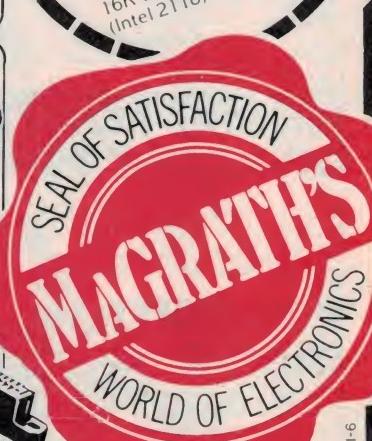
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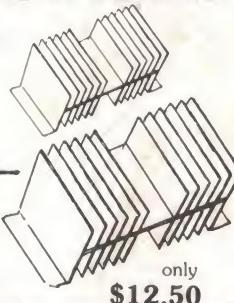
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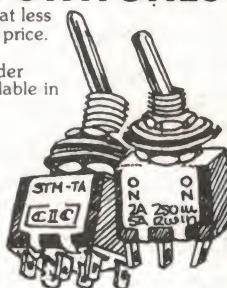
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## TRANSISTOR BARGAINS

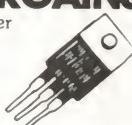
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Glover & Assoc. SE/10

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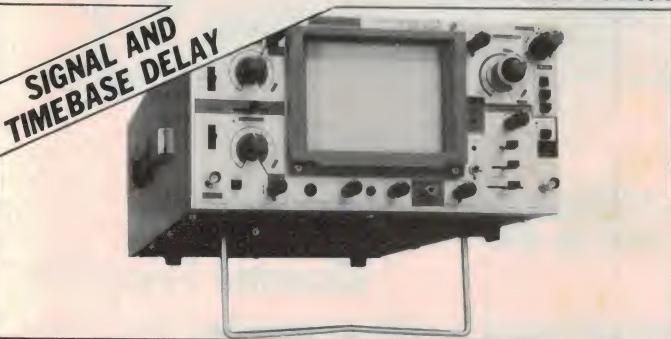
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601	20MHz	5mV	N	N	150mm	0.5μS - 0.5S/div
310	15MHz	2mV	N	N	95mm	0.5μS - 0.5S/div

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## Tacho calibrator

A handy test instrument for the motoring enthusiast. Installing and calibrating a new tacho is a pain in the exhaust. Here's the pill for the pain.

THIS PROJECT was developed initially to calibrate Smiths impulse tachometers, but with the addition of a transformer and diode can be used with peak reading or pulse types. The unit has also been useful in testing transistor-assisted ignitions by simulating the pulses from the distributor breaker points.

The calibrator is locked to the mains frequency — 50 Hz. It provides a selection of 14 different pulse rates from 25 Hz to 450 Hz in 25 or 50 Hz steps. Using the conversion chart, the pulse rate can be converted into RPM for the number of cylinders in the vehicle's engine.

### Construction

Two printed circuit boards are used and the whole unit is housed in a low cost ABS plastic case which is locally produced by Sigea in Melbourne (case model EC.1001). We 'dressed up' the front panel with Scotchcal.

One pc board holds the power supply and most of the circuitry, with the exception of one IC and the rotary switch, which are located on another smaller board along with a few other components. This board mounts behind the front panel of the case and connects to the main board via two lengths of ribbon cable.

Commence construction by using the larger pc board as a template to mark out mounting holes on the case bottom. Also mark out the mains cable inlet grommet hole and terminating block position. The front panel can be marked out using the Scotchcal as a template.

Drill the case, then mount and terminate the mains cable as indicated in the drawings.

Now you can start assembling the pc boards. Note the three links on the small pc board. LED1 actually mounts on this board, as does SW2. Make sure you cut the shaft of this switch to suit the knob you're using. Leave the leads of LED1 long and don't solder it in place

until you have determined how long they should be by making a trial assembly once all the other components are mounted. SW1 is wired to the board after mounting to the panel.

When assembling the larger pc board, leave T1 and C1 till last. Watch orientation of the ICs, transistors, diodes and polarised capacitors, as usual. Note that the ICs are CMOS types, so observe the usual handling precautions. Don't handle the pins, pick them up with thumb and forefinger on the ends of the package; solder the power supply pins first.

When mounting T1, secure it in place with two PK screws before soldering to the pins to avoid straining the pins and possibly breaking the wires terminated to them.

When both boards have been assembled and checked, wire them together with two lengths of 5-way ribbon cable about 130 mm long each. Solder flying leads to the 240 Vac input terminals on the board (use mains cable).

Then, mount the larger pc board in the case and terminate the 240 Vac input wires to the mains terminal block.

Attach the Scotchcal to the front panel of the case and mount SW1. Take care of the Scotchcal when tightening the nut. Solder three wires to its terminals and terminate them on the appropriate place on the small pc board. Then mount the small board. Take care when tightening the nut on the shaft of the rotary switch that you don't damage the Scotchcal.



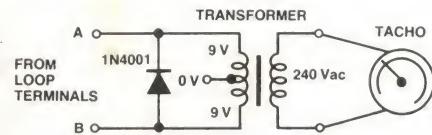
**Graeme Teesdale**

After a careful final check, you're ready to switch on.

### Testing it out

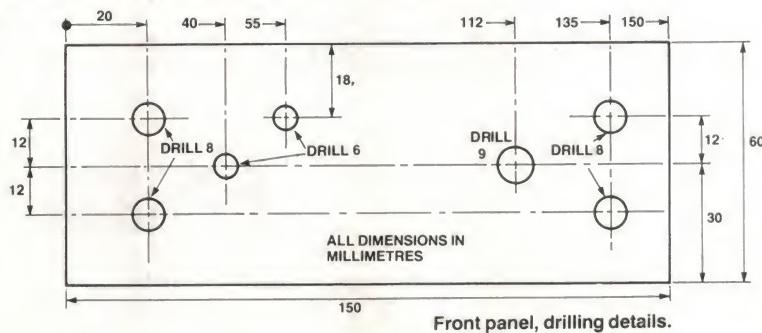
Set the range switch to position 1 and switch on. The pulse LED will flash at a rate of one second on, one second off. As you vary the range switch, the LED will flash at an increasing rate. If nothing's happening, then switch off and check your wiring, component orientation etc. See that supply voltage exists on the small pc board. Otherwise, you'll need either a logic probe or a CRO to fault-find.

If all is well, connect the primary loop of the pickup coil of a tachometer to the loop terminals. Vary the number of turns in the loop until the tachometer gives a reading. Use the accompanying table to determine the RPM, knowing the pulse rate and number of cylinders. Alternatively, if a peak reading or pulse type tacho is used, connect up the following additional circuitry:



Beware of the high voltage pulses on the secondary of the transformer in this circuit.

A little experimentation will show you how versatile this pulse generator can be. ▶



Front panel, drilling details.

# tacho calibrator

**PARTS LIST — ETI-165**

<b>Resistors</b>	.....	all 1/2 W, 5% unless noted
R1	.....	22k
R2	.....	8k2
R3	.....	1k5
R4	.....	100R
R5	.....	470k
R6	.....	27k
R7	.....	100k
R8	.....	10k
R9	.....	560R
R10	.....	1k
R11	.....	22R, 5 W

<b>Capacitors</b>	
C1	1000u/25 V axial electro.
C2	10n greencap
C3	1n greencap
C4	1u/16 V tant.
C5	22u/16 V RB electro.

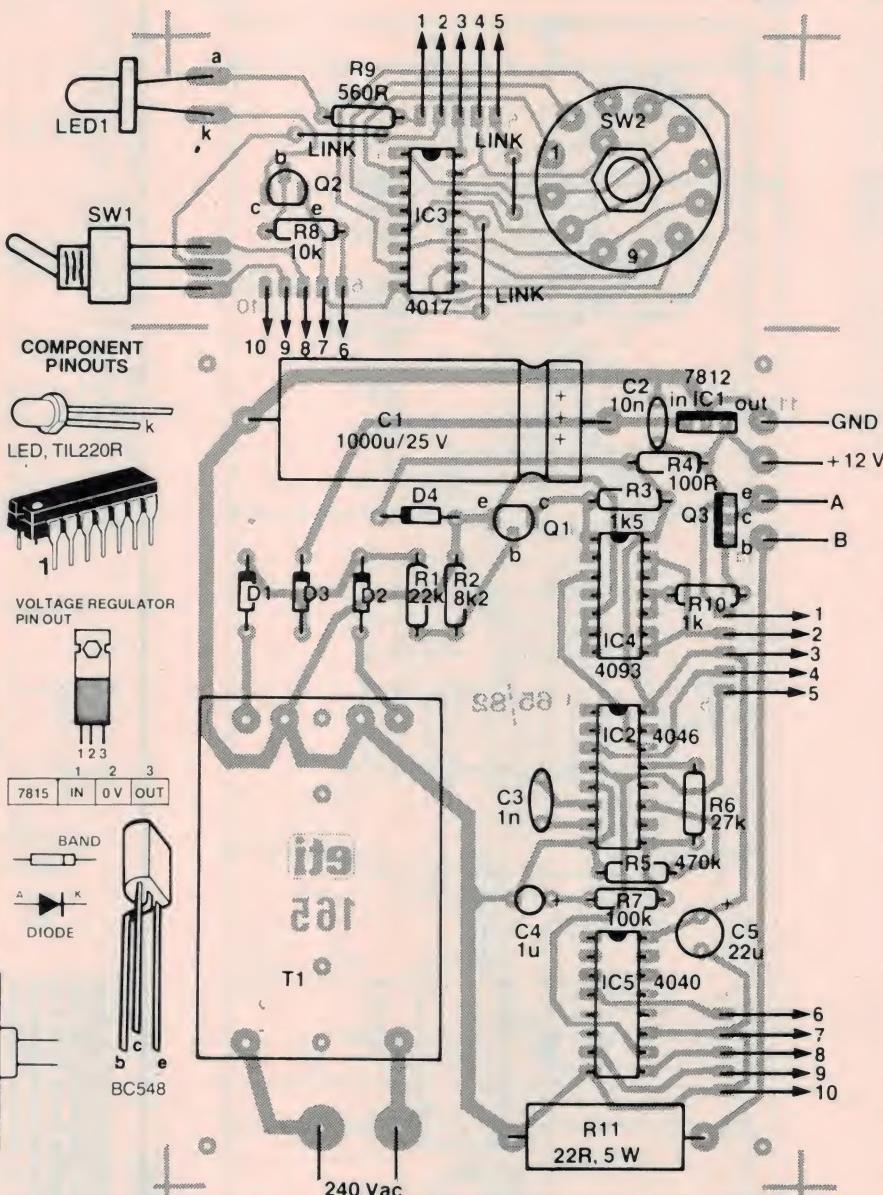
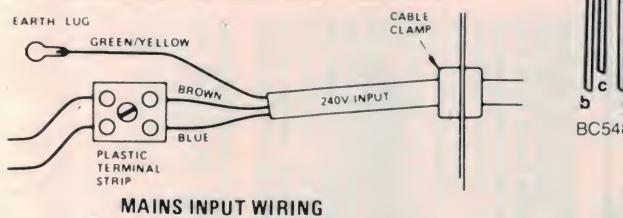
Semiconductors	
D1, 2, 3, 4	1N4001, EM401 etc.
IC1	LM340T/12, 7812
IC2	4046
IC3	4017
IC4	4093
IC5	4040
LED1	TIL220R red LED
Q1, Q2	BC548
Q3	BD266 or similar

## Miscellaneous

- TR1 ..... PL24/5 VA, Ferguson  
 SW1 ..... SPDT switch  
 SW2 ..... 1-pole, 9-position rotary  
             C&K Lorlin or similar.

ETI-165 pc board(s); two lengths of five-conductor ribbon cable (or hookup wire); case to suit; mains cord and clamp; etc.

**Price estimate \$36-\$40**



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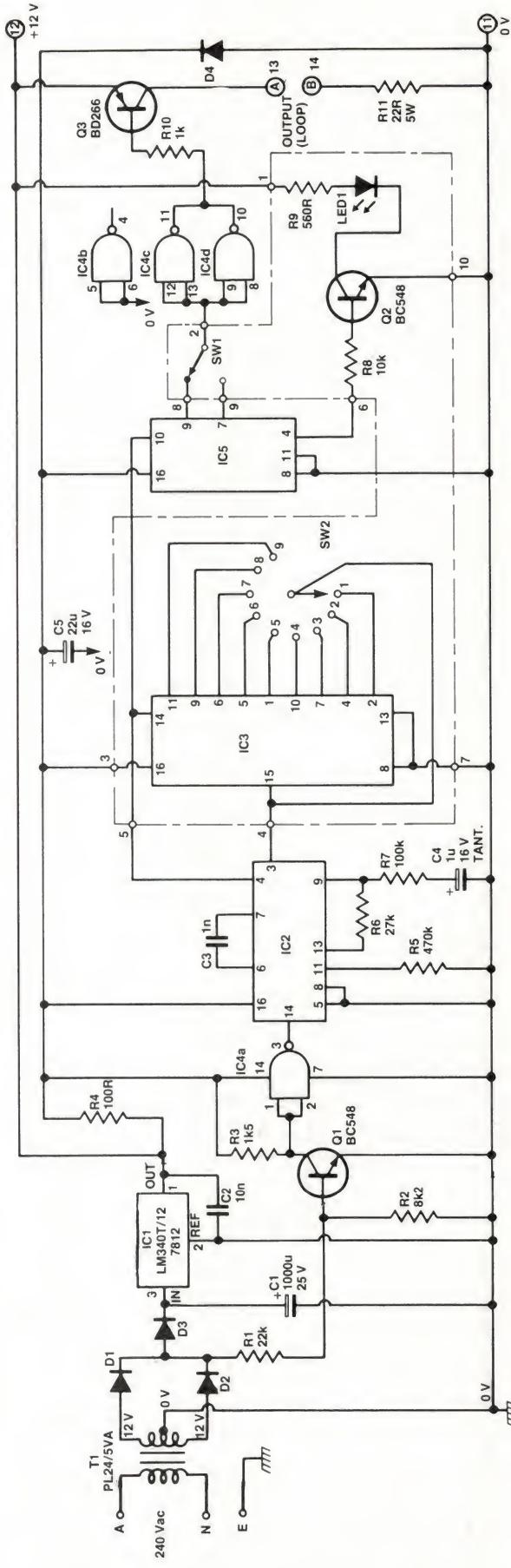
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# Project 165

## tacho calibrator



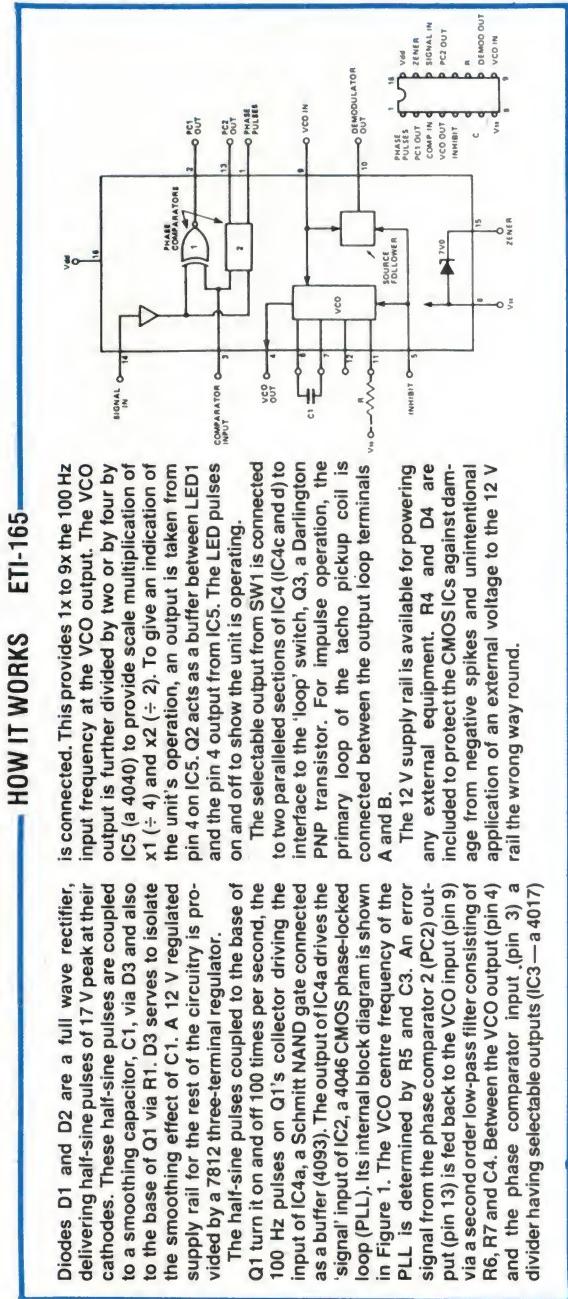
### HOW IT WORKS

Diodes D1 and D2 are a full wave rectifier, delivering half-sine pulses of 17 V peak at their cathodes. These half-sine pulses are coupled to a smoothing capacitor, C1, via D3 and also to the base of Q1 via R1. D3 serves to isolate the smoothing effect of C1. A 12 V regulated supply rail for the rest of the circuitry is provided by a 7812 three-terminal regulator.

The half-sine pulses coupled to the base of Q1 turn it on and off 100 times per second, the 100 Hz pulses on Q1's collector driving the input of IC4a, a Schmitt NAND gate connected as a buffer (4093). The output of IC4a drives the 'signal' input of IC2, a 4046 CMOS phase-locked loop (PLL). Its internal block diagram is shown in Figure 1. The VCO centre frequency of the PLL is determined by R5 and C3. An error signal from the phase comparator 2 (PC2) output (pin 13) is fed back to the VCO input (pin 9) via a second order low-pass filter consisting of R6, R7 and C4. Between the VCO output (pin 4) and the phase comparator input (pin 3) a divider having selectable outputs (IC3—a 4017)

RANGE	x1	OUTPUT	READING. pulses/sec.	READING. 4 cyl. tacho	READING. 6 cyl. tacho	READING. 8 cyl. tacho
1	1	25	750	509	375	375
2	2	1	50	1500	1000	750
3	3	75	2250	2250	1500	1125
4	4	2	100	3000	2000	1500
5	5	125	3750	2500	1875	1250
6	6	3	150	4500	3000	2250
7	7	175	5250	3500	2625	1687.5
8	8	4	200	6000	4000	3000
9	9	225	6750	4500	3375	2500
10	10	5	250	7500	5000	3750
11	6	300	9000	6000	4500	3375
12	7	350	10 500	7000	5250	3750
13	8	400	12 000	8000	6000	4500
14	9	450	13 500	9000	6750	4500

**NOTE:** Printed circuit board and front panel artwork is located on page 127.



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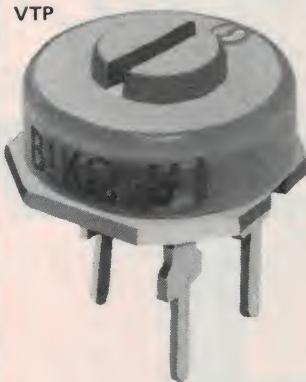
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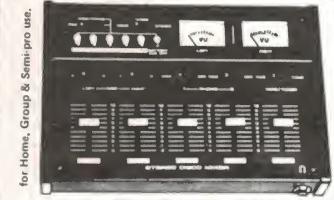
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40,000uF...30V...\$8.00  
8,300uF...40V...\$4.00  
5,500uF...45V...\$4.00  
20,000uF...45V...\$7.00  
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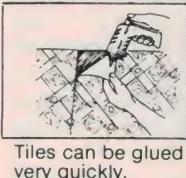
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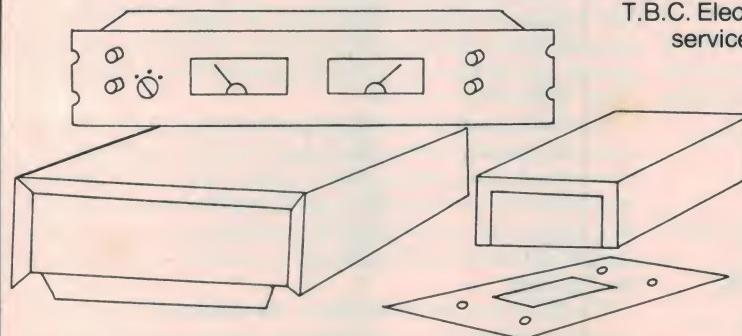
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## Voltage and window comparators

Comparators are circuits in which the output changes state when the input varies above or below a set limit, or within two limits. Applications abound.

**Ray Marston**

THERE ARE MANY occasions in electronics when it is necessary to have a circuit that abruptly changes its output stage when an input voltage, or a quantity that can be represented by a voltage (such as a current, resistance, temperature or light level, etc), goes above or below a preset reference value. Circuits that perform this basic function are known as voltage comparators.

Voltage comparators have plenty of practical applications apart from the obvious ones of over and under-voltage switches. They can readily be made to activate relays, alarms and other mechanisms when load currents or temperatures or light levels exceed, or fall within, preset limits, and have a stack of domestic and industrial uses. We'll look at some practical circuits in the next few pages.

### Basic voltage comparator circuits

The easiest way to make a voltage comparator is to use a CA3140 op-amp in one or other of the basic configurations shown in Figures 1 and 2. The 3140 op-amp has a typical basic

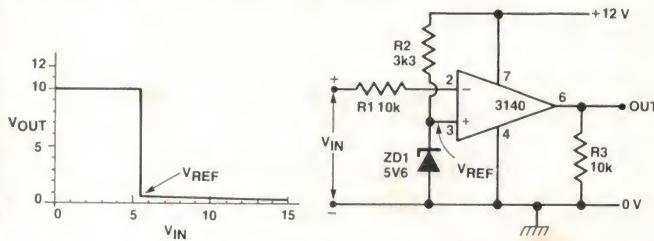


Figure 1. Basic op-amp comparator that functions as an under-voltage switch: the output is high when  $V_{IN}$  is below  $V_{REF}$ .

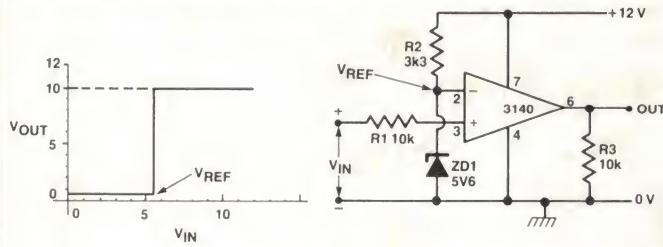


Figure 2. Alternative op-amp voltage comparator that functions as an over-voltage switch: the output is high when  $V_{IN}$  is above  $V_{REF}$ .

(open-loop) low frequency voltage gain of about 100 dB, so its output can be shifted from the high to the low state (or vice versa) by shifting the input voltage a mere 100 uV or so above or below the reference voltage value. This particular op-amp can be powered from either single-ended or split supply rails and provides an output that typically swings to within a couple of volts of its positive rail value or to within a few millivolts of its negative (or zero) supply rail value: Unlike many other op-amps, the 3140 can accept input voltages all the way down

to the negative rail value.

The operation of the Figure 1 circuit is very simple. A fixed reference voltage ( $V_{REF}$ ) is generated via  $R_2$ -ZD1 and is applied directly to the non-inverting input terminal (pin 3) of the op-amp, and the test or input voltage is applied to the inverting input terminal (pin 2) via current-limiting resistor  $R_1$ . When  $V_{IN}$  is below  $V_{REF}$  the op-amp output is driven high (to positive saturation), but when  $V_{IN}$  is above  $V_{REF}$  the output is driven low (to negative saturation) as shown in the diagram. The action of the circuit can be reversed, so that the op-amp output is normally low but goes high when  $V_{IN}$  exceeds  $V_{REF}$ , by simply transposing the pin 2 and pin 3 connections of the op-amp, as shown in Figure 2.

There are a few points worth noting about the basic single-supply Figure 1 and Figure 2 3140 voltage comparator circuits. The first point is that the 'reference' voltage can be given any value from zero up to within two volts of the positive supply rail value, so either circuit can be made to trigger at any desired value between these limits by simply interposing a preset pot between a fixed voltage-reference source and the ' $V_{REF}$ ' pin of the op-amp.

The second point to note is that the 'input' pin of the op-amp must be constrained to the range from zero volts up to within two volts below the positive supply rail value. Thus, if you want the circuit to trigger at some high value of input voltage, this action can be obtained by feeding the input voltage to a simple potential divider before it reaches the actual input of the op-amp.

The final point to note about the basic voltage comparator circuits is that they give a non-regenerative switching action, so that the op-amp is driven into the linear (non-saturated) mode when the 'input' voltage is within a few tens of microvolts of  $V_{REF}$ , and under this circumstance the op-amp output generates lots of spurious noise. In some applications this type of action may be unacceptable, in which case the problem can be overcome by feeding a small part of the op-amp output voltage back to the non-inverting input terminal, so that a regenerative switching action is obtained. The feedback signal introduces a degree of hysteresis in the voltage switching levels, the degree of hysteresis being directly proportional to the amount of feedback.

### Special voltage comparators

Figures 3 to 7 show how the three points mentioned above can be put to practical use to make various types of 'special' voltage comparator circuits; plenty of other variations are possible.

Figures 3 and 4 show how the basic comparator circuits can be modified to give variable-voltage switching by using a pre-set pot (PR1) to set the desired 'reference' or trigger voltage at any value in the range 0 — 5V6, and to give regenerative ('noiseless') switching by feeding part of the op-amp output back to the non-inverting terminal via  $R_3$ ; note in the Figure 4 circuit that the input terminal is terminated via  $R_5$ , to ensure controlled hysteresis.

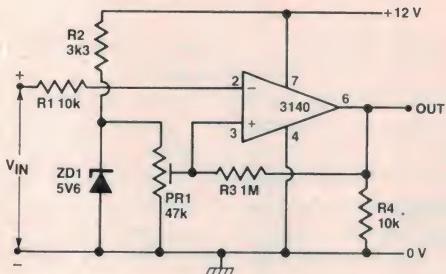


Figure 3. Variable under-voltage switch with degenerative feedback overcomes intermediate-voltage problems with Figure 1 and 2 circuits.

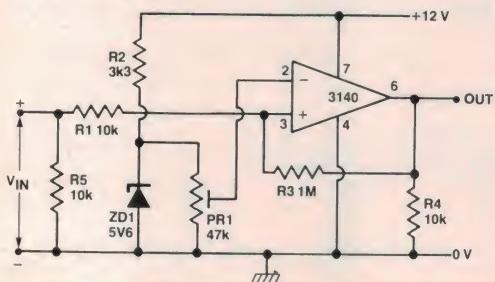


Figure 4. Variable over-voltage switch with regenerative feedback.

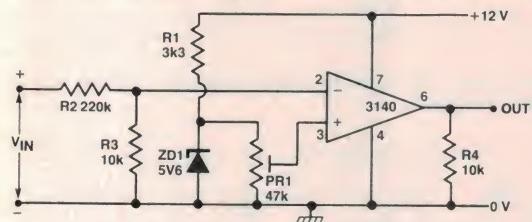


Figure 5. High value (0 — 130 V) under-voltage switch.

Figures 5 and 6 show examples of how the circuits can be modified to give high-value variable-voltage (0 — 130 V) triggering by interposing a simple potential divider (R2-R3) between the input signal and the input of the op-amp: The Figure 5 circuit gives non-regenerative switching, while the Figure 6 circuit gives regenerative switching.

Finally, Figure 7 shows how the comparator can be used as a sensitive audio sine-square converter that can operate from input signal amplitudes as low as 10 mV peak-to-peak at 1 kHz and which produces decent squarewave outputs from sinewave inputs with frequencies up to about 15 kHz. Input impedance is 100 k $\Omega$ .

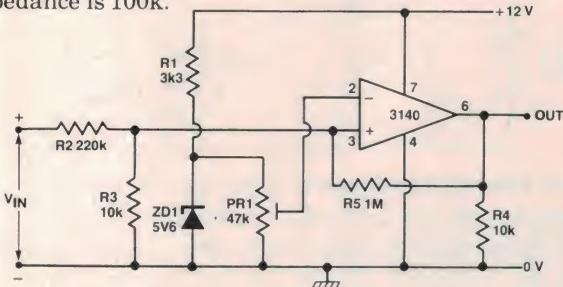


Figure 6. High value (0 — 130 V) regenerative over-voltage switch.

The operation of the Figure 7 circuit is simple. Voltage divider R1-R2 and capacitor C2 apply a decoupled reference voltage to pin 2 of the op-amp and an almost identical voltage is applied to signal-input pin 3 via isolating resistor R3. When a sinewave is fed to pin 3 via C1 it swings pin 3 about the pin 2 reference level, causing the op-amp output to change state at

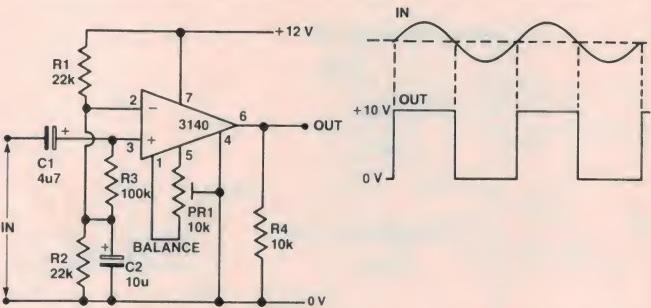


Figure 7. This sensitive sine-square converter needs only a few tens of millivolts of input signal to produce a decent squarewave output up to about 15 kHz.

the 'zero voltage difference' crossover points of the input waveform and produce a squarewave output. Preset pot PR1 is used to bias the op-amp so that its output is just pulled low with zero input signal applied, so that the circuit operates with maximum sensitivity and stability. Note that, because of the gain-bandwidth product characteristics of the op-amp, the circuit sensitivity decreases as the input frequency is increased.

## Window comparators

The voltage comparator circuits that we've looked at so far give an output transition when the inputs go above or below a single reference voltage value. It's a fairly simple matter to interconnect a pair of voltage comparators so that an output transition is obtained when the inputs fall between, or outside of, a pair of reference voltage levels. Figure 8 shows the basic circuit configuration, which is generally known as a *window comparator* or *discriminator*.

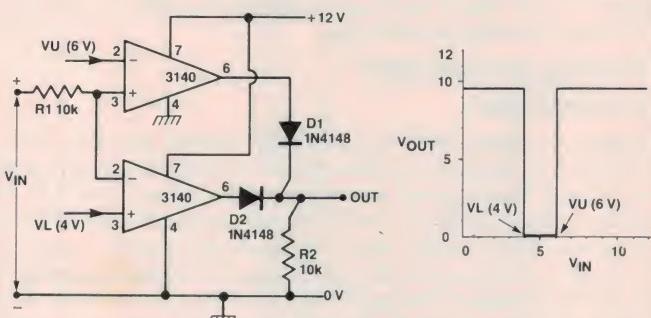


Figure 8. A voltage window comparator or discriminator. The output goes high when  $V_{IN}$  goes outside of the  $V_L$  or  $V_U$  limits.

The action of the Figure 8 circuit is such that the output of the upper op-amp goes high when  $V_{IN}$  exceeds the six volt  $V_U$  'upper limit' reference value, and the output of the lower op-amp goes high when  $V_{IN}$  falls below the four volt  $V_L$  'lower limit' reference value. By feeding the outputs of the two op-amps to  $R_4$  via the  $D_1$ - $D_2$  diode OR gate we get the situation where the final output is low when  $V_{IN}$  is within the limits set by  $V_U$  and  $V_L$ , but goes high whenever the input goes beyond these limits.

The action of the Figure 8 circuit can be reversed, so that its output goes high only when the input voltage is within the 'window' limits, by taking the output signal via a simple inverter stage. Alternatively, the required action can be obtained by transposing the two reference voltages and taking the output via a diode AND gate, as shown in Figure 9.

Window discriminators can readily be made to activate from any parameter that can be turned into an analogue voltage, in the same way as a 'normal' voltage comparator can. They can thus be used to activate relays or alarms whenever temper-

# circuit file

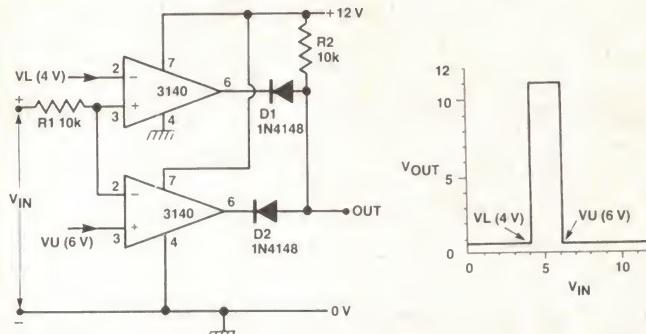


Figure 9. An alternative window discriminator in which the output goes high when  $V_{IN}$  falls between the two limits.

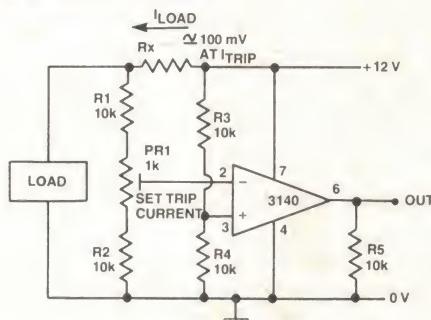


Figure 10. An over-current switch: the output goes high when the load current exceeds a preset value. The action can be reversed by transposing pins 2 and 3 of the op-amp.

atures, voltages, currents or light levels etc, go outside of preset limits. Let's look now at some examples of 'analogue-activated' comparator circuits.

## Analogue-activated comparators

Figure 10 shows how a comparator circuit can be made to function as an over-current switch that gives a high output when the load current exceeds a value preset via PR1; the value of  $R_x$  is chosen so that it develops roughly 100 mV at the required trip current level. A fixed half-supply 'reference' voltage is fed to pin 3 of the op-amp via  $R_3-R_4$  and a similar but current-dependent voltage is fed to pin 2 via  $R_x-R_1-PR_1-R_2$ ; in effect, these two sets of components are configured as a Wheatstone bridge, with one side feeding pin 3 and the other side feeding pin 2, and the op-amp is used as a bridge-balance detector; consequently, the trip points of the circuit are not significantly influenced by supply voltage variations but are highly sensitive to load current variations.

Note that the action of the Figure 10 circuit can be reversed, so that it functions as an undercurrent switch, by simply transposing the connections to pins 2 and 3 of the op-amp. The circuit can then be used as a lamp or load-failure indicator in cars or in test gear, etc.

Figure 11 shows the circuit of a sensitive ac over-voltage switch, which gives a high output when the input signal exceeds a peak value (6 mV to 111 mV) preset via PR1. The ac input signal is applied to the input of non-inverting variable gain amplifier IC1, which has its gain variable from  $\times 45$  to  $\times 850$  via PR1. Note that the input of IC1 is dc-grounded via  $R_1-R_2$ , so the op-amp responds only to the positive half-cycles of the input signal. Consequently, the output of IC1 is an amplified but positively half-wave rectified version of the input signal; this signal is peak-detected via  $R_5-D_1-C_2-R_6-R_7$  and fed to the input of non-inverting voltage comparator IC2,

which thus gives a positive output when the  $C_2$  voltage exceeds the value on the junction of  $R_8-R_9$ .

Figures 12 to 15 show a variety of ways of using comparator circuits as light or temperature-activated switches. All of these circuits use a light or temperature-sensitive transducer (and LDR or cadmium sulphide photocell for light, or a negative-temperature-coefficient thermistor for temperature) as the sensing element and use the element as one arm of a Wheatstone bridge and the op-amp as a simple bridge-balance detector so that the 'trip' point of each circuit is independent of supply line variations. In all cases, the sensing element must have a resistance in the range 5k to 100k at the required 'trip' point and PR1 is chosen to have the same resistance value as

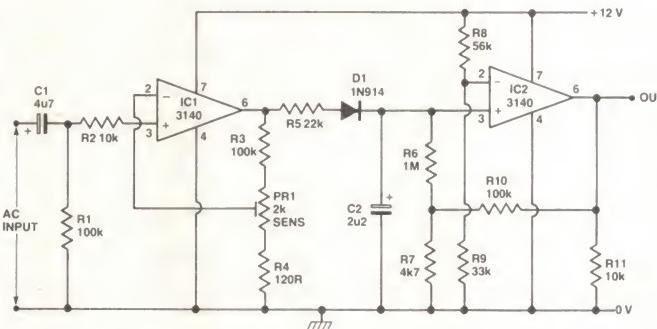


Figure 11. This ac over-voltage switch can be triggered by input signals in the range 6 mV to 111 mV peak.

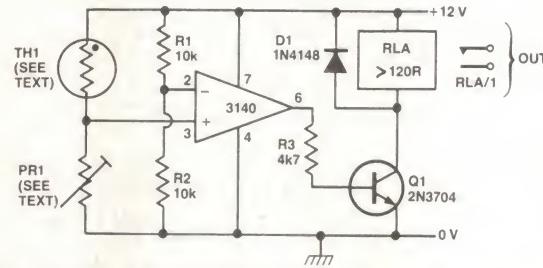


Figure 12. Precision over-temperature switch with transistor/relay output.

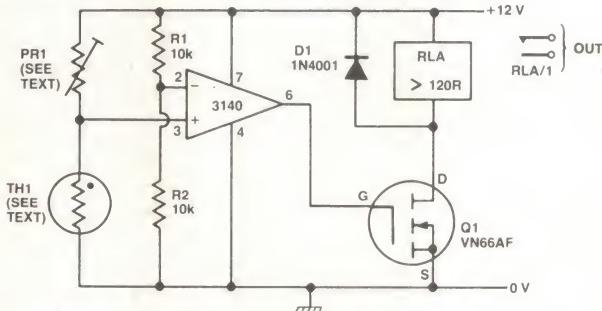


Figure 13. Precision under-temperature switch with VFET/relay output.

the sensing element at the required trip level.

The Figures 12 to 15 circuits also show a variety of ways of using the output of the op-amp to activate a relay or to generate an acoustic alarm signal. Thus, the Figure 12 over-temperature switch has a transistor-driven relay output, while the Figure 13 under-temperature switch has a VFET-driven relay output. Similarly, the light-operated switch circuit of Figure 14 generates a monotone alarm output signal in a small speaker, while the dark-operated switch of Figure 15 generates a low-power pulsed-tone signal in a small piezoelectric transducer.

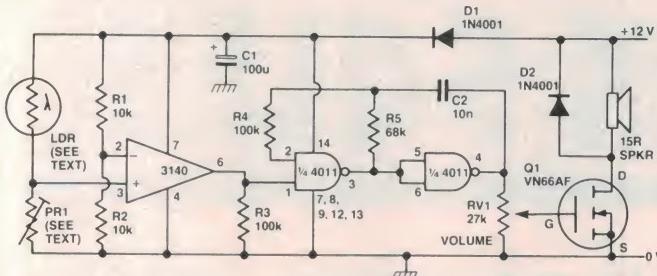


Figure 14. Light-operated switch with monotone alarm output.

## **Micro-power operation**

All of the 3140-based comparator circuits that we have looked at so far are continuously powered; they draw continuous currents of about 4 mA per op-amp and will thus flatten a small 9 V battery in less than two days of continuous operation. These circuits are thus not well suited to battery operation in 'portable' applications. In practice, however, all of these circuits can easily be modified for long-life battery operation by using a micro-power 'sampling' technique; the principle can be explained with a simple example, as follows.

The Figure 13 under-temperature switch circuit monitors temperature continuously and draws about 5 mA of quiescent current (with the relay off). In reality, however, temperature is a slowly-varying parameter and thus does not need to be monitored continuously; instead, it can be efficiently monitored by briefly 'inspecting' or 'sampling' it (by connecting the supply power and inspecting the op-amp output) only once every second or so; if the sample periods are very brief (say 300  $\mu$ s) relative to the sampling interval (one second), the *mean* current consumption of the monitor can be reduced by a factor equal to the interval/period ratio (e.g. by a factor of 3300) by using the sampling technique, so that, for example, the 5 mA consumption of the Figure 13 circuit can be reduced to a *mean* value of a mere 1.6  $\mu$ A, thus giving years of continuous operation from a 9 V battery. The 'sampling' technique thus enables true micro-power monitor or comparator designs to be implemented.

Figure 16 shows the basic circuit of a 'micro-power' or sampling version of the Figure 13 under-temperature switch, which operates the relay when the TH1 temperature falls below a preset value but which draws a mean quiescent current of only a few uA. The TH1-PR1-R1-R2-IC1 monitor network is almost identical to that of Figure 13, but instead of being continuously powered it is powered via a 300 uS pulse just once every second via a sample-pulse generator and Q1.

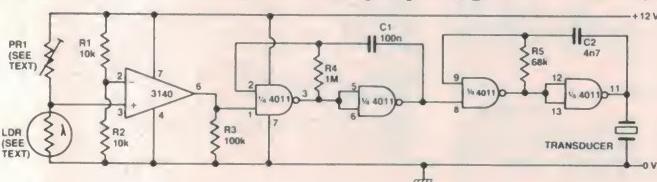


Figure 15. Dark-operated switch with low-power pulsed-tone output.

Note that the output of IC1 is fed to temporary 'memory' store R4-C1 via D1, and that the memory store operates the relay via VFET Q2.

Thus, if the TH1 temperature is outside of the trip level when the sample pulse arrives, IC1 output will remain low and no charge will be fed to C1, so Q2 and the relay will be off, but if the TH1 temperature is within the trip level when the sample pulse arrives the IC1 output will switch high for the duration of the pulse and thus rapidly charge C1 up via D1 and thence drive the relay on via Q2; the C1 charge will then easily hold

the relay on until the arrival of the next sample pulse.

The Figure 16 circuit, then, illustrates the basic principles of the micro-power sampling technique. In reality the sampling interval and pulse-width used (and thus the reduction in mean power consumption) will depend on the specific application. If, for example, you wish to monitor transient changes in light or sound levels and know that these transients have minimum durations of 100 mS, you may have to use a 50 mS sampling interval and (say) a 500 uS sample pulse, in which case the mean consumption of your circuit will be reduced by a factor of 100.

In some cases you may have to slightly modify the operating principle of the sampling circuitry to obtain the desired micro-power operation. Figure 17, for example, shows how the

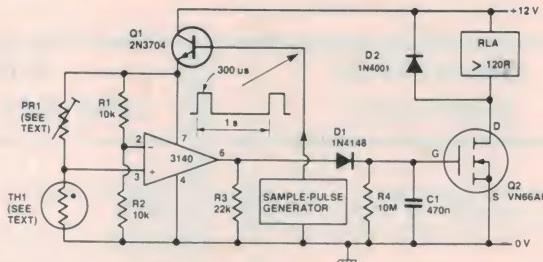


Figure 16. This micropower or 'sampling' version of the Figure 13 under-temperature switch draws a mean quiescent current of only a few microamps.

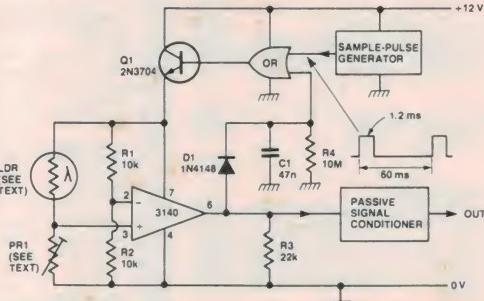


Figure 17. This coded light beam detector circuit uses a modified version of the micropower 'sampling' technique.

principle may be adapted to make a coded lightbeam detector, in which the 'code' light signal is modulated at 1 kHz for a minimum duration of 100 mS. Thus, the sample-pulse generator is designed to produce a minimum pulse width of 1.2 mS so that it can 'capture' at least one full 1 kHz code cycle, and the sampling interval is set at 60 mS so that part of a tone burst will always be captured. The sampling circuitry thus gives a 50:1 reduction in monitor current consumption.

Thus, in the Figure 17 circuit, the sample generator repeatedly feeds 1.2 mS 'inspection' pulses to the 3140 detector circuitry via one input of the OR gate and via Q1 to see if any trace of a coded signal exists. If no trace of a code signal is detected the output of the op-amp remains low and another sample pulse is applied 60 mS later, but if a trace of a code signal is detected the output of the op-amp immediately switches high and the resulting pulse is 'captured' by C1 via D1 and applied to the remaining input of the OR gate, thereby temporarily applying full power to the 3140 circuitry so that the code signal can be properly inspected via the passive signal conditioning circuitry to see if it conforms to the specified 'code' characteristics.

Note that, for a sampling system to be truly efficient, the actual sample-pulse generator must itself consume negligible current and may thus have to be a non-standard design. We'll show some possible suitable circuits in the next edition of 'Circuit File'.

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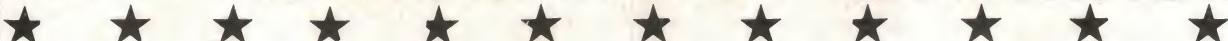
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continued on page 62

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DAVID TILLBROOK HAS DONE IT AGAIN!! 5000 SERIES 1/3



## 5000 SERIES GRAPHIC EQUALISERS



Latest addition to the thoroughbred 5000 Series stable! David Tillbrook has once again produced a 'No Compromise' design. This new component, a 1/3 octave equaliser, gives you ABSOLUTE CONTROL over the acoustics of your particular listening environment. You get 3 SEPARATE CONTROLS for every octave of audio bandwidth to virtually eliminate the subtle nuances that are particular to your listening area.

1/3 octave equalisers have been used by professional engineers in Recording Studios and live concerts for over a decade now. It is no accident that the advent of the 1/3 octave equaliser and studio quality live sound have gone hand-in-hand. BUT THERE'S A CATCH. One of these equalisers is not enough. You will have to buy 2 (for stereo). Quite a lot of money — but worth it if you want the best.

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BUY 2 AND SAVE \$10 — ONLY \$389

**only  
\$199**

## "BLACK MONOLITH"



**ONLY  
\$299**

Once again, imitation is the sincerest form of flattery. The Black Monolith 5000 Mosfet Power Amp has the following EXCLUSIVE features:

- Beryllium Oxide (Space Age ceramic) TO 3 washers. (Not flimsy mica)
- Jig drilled and extruded heavy gauge, anodised heatsink bracket.
- SUPERFINISH front panel. STILL THE BEST now with blind tapped holes.
- New heavy duty heatsinks for the driver transistors. 100% extra heatsink area and black anodised for greater efficiency. (Not in original design).
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- Extra 3 pin DIN socket on rear panel (total 2) to power new 5000 components. (1/3rd Octave 5000 series Equaliser coming soon!). Not in original design but now a must with the new additions in the family.

IF YOU THINK THAT YOU CAN SAVE MONEY ON THESE KITS ASK YOUR SUPPLIER IF HE WILL GIVE YOU ALL OF THESE FEATURES AT THE PRICE. MAKE SURE THAT YOU GET IT IN WRITING!!

A PRICE RISE ON BOTH KITS (i.e. SALES TAX AND METALWORK ETC.) IS EXPECTED SOON! BUY THE BEST FOR NO MORE.

Write in (SAE) for a new glossy leaflet on both amps.

### SPECIFICATIONS

POWER OUTPUT  
FREQUENCY RESPONSE

Around 100W RMS into 8 ohms  
8Hz to 20kHz, +0 — 0.4dB  
2.8Hz to 65kHz, +0 — 3dB

Note: these figures are determined solely by passive filters

INPUT SENSITIVITY  
HUM  
NOISE  
2nd HARMONIC DISTORTION

1V RMS for 100W output  
— 100dB below full output (flat)  
— 116dB below full output (flat, 20kHz bandwidth)  
<0.001% at 1kHz (0.0007% on prototypes) at 100W output using a 56V supply rated at 4A continuous

<0.0003% at 10kHz and 100W  
<0.0003% for all frequencies less than 10kHz and all powers below clipping

Determined by 2nd harmonic distortion (see above)

<0.003% at 100W (50Hz and 7kHz mixed 4:1)

Unconditional

## "BLUEPRINT" 5000 PREAMPLIFIER



"One Swallow does not make a spring!"

— Neither does a few gold RCA sockets!

Several of our competitors are imitating our "Blueprint" preamp by adding a few bits and pieces, notably gold plated RCA sockets to their standard kits. Unfortunately they have missed the point. We supply gold plated sockets in our "Blueprint" preamp but only where it makes sense to do this, i.e. on the inputs — NOT the outputs. 16 gold sockets are provided by us. This, however, does not make a "Blueprint". THIS DOES:

- Low capacitance screened cable . 12 metres of it. NOT Taiwanese cable as supplied in other kits. Our cable costs us NEARLY 5 TIMES MORE than the Taiwanese stuff.
- Original ETI designed front panel. Not an "ADAPTION". Our front panel is by far the nicest.
- Factory pre-tinned PCB's to reduce chances of dry or noisy solder joints.
- Quality LEDs, polished finish, multicoloured display.
- IC sockets and line amp board.
- Special rear panel.
- Special low noise selection LM394H NOT CH device in M.C. preamp.
- Thermalloy (U.S. made) heatsink on 7805 regulator.
- English Lorlin selector switches.
- Apart from the 16 gold RCA's we throw in a pair of gold plated line RCA plugs — worth \$5.
- Special Nylon rear panel grommets.

So don't "Swallow" the facts before they are properly digested!!  
You can't make a silk purse out of a sow's ear. Send SAE for full specs.



**BLUEPRINT \$275**

### SPECIFICATIONS

Frequency Response	High level input: 15Hz-130kHz, +0, -1dB Low level input: conforming to RIAA equalisation ±0.2dB (less than 100Hz, 100Hz, 1kHz, 10kHz, 100kHz, 1000Hz, 10000Hz)	Gain	1%, 1kHz	Conforms to RIAA Equalisation	=0.2dB
Distortion	0.0003% on all inputs (limits of resolution on measuring equipment due to noise limitations)	Headroom	2dB@B with respect to 5mV RMS input signal, i.e. 135mV RMS		
S/N noise	1kHz 0.0003% on all inputs (limits of resolution on measuring equipment due to noise limitations)	Noise	Total equivalent input noise, 122mV, Input shorted, 2.16mV flat, Input shorted		
	HIGH 1000Hz 0.0003% on all inputs (limits of resolution on measuring equipment due to noise limitations)	S/N ratio	Flat 1mV 10mV A-weighted 72dB 82dB 92dB		
	300mV Input signal at full output(1.2V) : 92dB flat, 100dB A-weighted	ETI-478MC Moving coil input stage	2dB@B with respect to 5mV RMS input signal, i.e. 135mV RMS		
	MM Input, master full, with respect to full output (1.2V) at 5mV input, 500 ohm source range, 1000V comp. 86dB flat	Frequency Response	Total equivalent input noise 80mV, Input shorted 42mV flat, Input shorted		
	92dB flat	Total Harmonic Disorder Noise	0.0003%, 1kHz, 30mV Input		
	MC Input, master full, with respect to full output (1.2V) and 290mV input signal 71dB flat 75dB A-weighted	ETI-478MC Moving coil input stage	24 7Hz-135kHz ±0, -1dB		
		Frequency Response	0.0003%, 1kHz, 30mV Input		
		Total Harmonic Disorder Noise	80mV, Input shorted 42mV flat, Input shorted		
		Noise	56mV flat, after RIAA Eq. Input shorted 34mV 'A', after RIAA Eq. Input shorted		

# SERIES COMPONENT

OCTAVE GRAPHIC EQUALISER — BRILLIANT!!



★ ★ ★ ★ ★  
8 CHANNEL MIXER  
KIT

FROM  
\$495

The Jaycar 8002 Mixer was originally conceived to be the successor to the very popular ET1414 Master Mixer. The 414 was basically configured as a 'stage' mixer and suffered from a number of severe technical limitations — notably poor signal-to-noise figures. Enormous advances in audio IC's have occurred since the 414 was designed. Jaycar engineers have taken advantage of this. The incredibly low noise and distortion figures of the 8002 are due to the sound basic design of the mixer coupled with the performance capability of these IC's. Whilst the 8002 is the usual 8 channel compact stage mixer, other applications have been kept in mind.

AS A "STUDIO" MIXER — The main requirement of a studio mixer is that it must be quiet — i.e. have good S/N. Due to the fact that the "miracle" of S/G IC's has occurred, the 8002 studio applications are entirely feasible.

In addition to this, metal film resistors are used in critical signal paths. AS A DISCO MIXER. The balanced input feature of the 8002 is not really necessary for disco use. This section can easily be bypassed with either a moving magnet (Dynamic Cartridge) preamp, or a moving coil preamp. The sensible format of the 8002 and tremendous equalization facilities should make this mixer popular for disco use.

- Balanced (600 Ohm) Mic. Inputs/Line Inputs.
- Cannon Connectors included in the price.
- Bass, Mid & Treble Equalization on each Input.
- "Effects" (i.e. Echo etc.) capability.
- Foldback and Stereo Pan on ALL 8 Inputs.
- 60mm Slide Faders used throughout.
- 19" Rack Mount capability (or Console Mount).
- Professional Black Front Panel with Format borders & multi-coloured knobs to assist function identification.
- VU Metering.

Send SAE for  
full details +  
details on use  
as stage mixer

## ★ ★ ★ ★ ★ WIRELESS GUITAR LINK — low cost breakthrough!



NOT  
A KIT  
BUILT AND  
TESTED

ONLY  
\$149.50



### SPECIFICATIONS

EFFECTIVE RADIATED  
POWER OF TRANSMITTER

30mW

RELIABLE RANGE

Over 50 metres

INPUT SENSITIVITY

Variable down to  
15mV (RMS)

SIGNAL TO NOISE

60db with typical  
tuners

TUNABLE FREQUENCY

88 - 100 MHz (ie low  
(unused) part of FM  
band)

FREQUENCY RESPONSE

10Hz to 16kHz  
(Flatter than most  
tuners)

FREQUENCY STABILITY

Similar to the  
frequency stability of  
high quality FM tuner

DIMENSIONS

40 x 40 120mm

BATTERY LIFE

25 hours continuous  
(alkaline)

FACILITIES

Nicad charging socket  
low battery indicator  
LED mounting clip

Now you can roam almost anywhere without the hassle of a trailing cord back to the mixer or amp. The Muso-link simply clips to either your belt or guitar strap and transmits back to any FM tuner. IT works on the largely unused section of the Australian FM band. The FM tuner then connects to the PA direct or thru a mixer. The results are spectacular and reliable. The transmitter is very stable. The massive price reduction is due to the fact that you don't need a special crystal controlled receiver, just your FM tuner.

## 'super siren'

Incredible CMOS circuit drives a Motorola piezo horn (KSN 1038A) to achieve extremely high sound pressure levels. Makes a great alarm and only draws — would you believe — 5mA average? Runs for ages on a 9V battery. You can get the electronics including the PCB for only \$5.00. KSN1038A only \$17 extra.

Ref: EA 11/82 FROM \$5.00



EA KITS	
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PC Birds — Duelling Canary Sound Ref: EA5/81	\$14.50
Cudlipp Cricket — Circuit driver you crazy Ref: EA2/82	\$12.50
Vocal Canceller — Insert your voice onto records Ref: EA4/82	\$19.50
VOX Relay — Open doors with a handclip Ref: EA4/82	\$14.50
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### ETI KITS

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446 — Audio Limiter	\$9.95
479 — Bridging Adaptor ET13/82	\$79.50
493 — 150W MOSFET P.A. Amplifier ET13/82	\$39.50
496 — Preamplifier for above	\$23.00
480/150 — 100W Economy amplifier — quality version	\$27.00
480/100 — 100W Economy amplifier — quality version	\$29.50
158 — Low Ohm Meter ET11/181	\$25.00
729 — UHF Masthead Amplifier	\$32.50
735 — 1000 Series MOSFET Module	\$59.00
477 — 5000 Series MOSFET Module — Quality	\$29.50
478MC — 5000 Series Moving Coil Preamplifier	\$19.50
478MM — 5000 Series Moving Magnet Preamplifier	\$29.50
458 — 5000 Series Peak Reading Level Meter	\$29.50

KITS  
from  
**EA**  
**ETI**

Ref: EA 11/82

NEW

'Power UP'



**\$39.50**

What will they think of next??!! Sensational project that detects the current drawn by one appliance to switch on up to 4 others — AUTOMATICALLY!

Great for computers, component Hi Fi etc. when you have to normally switch on several items in a system. Will switch total load of 240V 10A.

Complete kit including outlets, box, mains relay etc. ONLY \$39.50

Jaycar

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MINIMUM  
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\$5.00

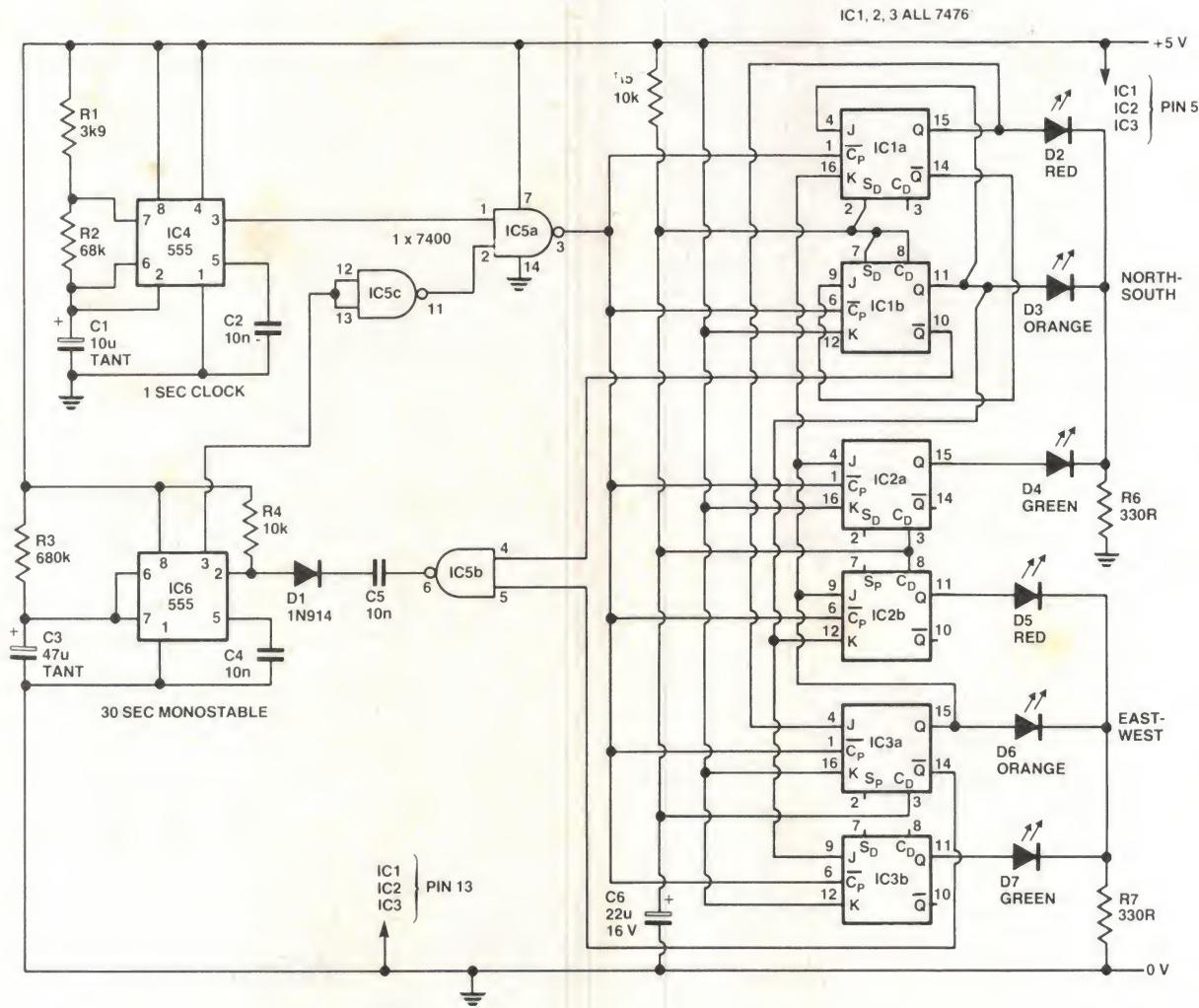


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\$100 up (\$6.20)

NEW SHOP HOURS  
Mon-Fri 8.30 to 5.30pm  
Sat 8.30 to 12.00pm  
Thurs night to 8.30pm

# Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



## Traffic lights

This circuit for a traffic light system that can be used in model town applications or for a child's toy has been designed by C.A. Symes of Flynn ACT.

The six JK flip-flops form a sequence counter to achieve the same sequence of operation as traffic lights using red, green and orange LEDs.

When the circuit is switched on, R5 and C6 set the flip-flops IC1a and IC3b and the other four flip-flops are reset. This turns the lights on in the correct sequence.

A one second clock is formed by IC4 and its associated circuitry, but the clocking of the flip-flops is inhibited by the NAND gate IC5a. IC6 forms a 30 s monostable flip-flop. Pin 3 is usually high for 30 s, then it goes low and the gate IC5a goes high and the clock then pulses the flip-flops.

The traffic lights then change from orange to red (green in the other direction) at a 1 s step rate. IC5b output changes from low to high as either orange light switches on. When the

orange light switches off and the red goes on the output of IC5b goes low. This sends a pulse through the diode D1 which causes the monostable output to go high again and disables gate IC5a again for a further 30 s.

Resistor R4 holds the trigger line of IC6 high to prevent false triggering of IC6.

# ★ AUDIO KITS ★

JAYCAR IS NUMBER 1

## ★★★ subwoofer sensation

Ref: Electronics Australia June-August 1982

### THE SUB-WOOFER

MODEL SW 250



**ONLY \$79.50**

This unit has been extremely popular with audio enthusiasts right across Australia! EA have designed a special crossover/booster amp just for this unit. Now you have no excuse to build a subwoofer system to enjoy those thrilling low notes from pipe organs, synthesisers, 1812 cannons etc!!

#### SPECS:

Diameter 10" (250mm) Cast Frame, QT=0.39, VAS=631 Power Handling = 100WRMS. Free-air Resonance 32Hz ±1Hz Voice Coil = 2" (51mm), Dia. Magnet Assy = 3kg (6.6lbs).

A FREE SUB-WOOFER CABINET DESIGN IS PROVIDED WITH EACH UNIT!!

### THE ENCLOSURE



**ONLY  
\$79.50**

This compact 63 litre vented enclosure was specifically designed around the parameters of the SW250 Sub-Woofe. It follows the theory pioneered by the work of Thiele, Small and Snyder. The Jaycar enclosure is easy to build and is made of high quality durable materials. The heavy walled cabinet is covered with an attractive black vinyl veneer. All timber is pre-cut and the black grille is already made. Assembly takes less than one hour.

NB. The photo shows the prototype which was finished in white. The production units are only available in black Freight anywhere in Australia only \$10.00.

### AMPLIFIER/FILTER UNIT

#### AMPLIFIER/FILTER UNIT.

Amplifier Module \$79  
Transformer to \$39.50  
suit  
Metal case specially made  
to suit including front  
panel, hardware etc. (not a  
twin 25 case). Only \$29.50  
\$148.00

Buy the lot for only  
\$125.00 if you purchase  
the enclosure and woofer  
at the same time.

REF. EA JULY 1982

State-of-the-art power Mosfet technology combined with an active low pass filter results in a sub-woofer amp without equal anywhere!!

FEATURES: Around 100WRMS Drive capability.  
Low pass (sub-woofer) filters on board.  
Can hook-up to pre-amp or power-  
amp out.

Power supply on board.  
(Transformer needed. ONLY \$39.50)

**ONLY  
\$79**



### MARC NR82 MULTIBAND RECEIVER

AS REVIEWED IN ELECTRONICS AUSTRALIA AUGUST 1982  
Virtually continuous coverage from 145kHz to 470MHz in all modes.  
AM, FM, SSB, CW. Built-in VFO, Squelch, RF Gain, Antenna trim  
and dozens more features!!  
Measures a huge 484(H) x 355(W) x 165(D)mm and weighs 5 kilos (plus  
batteries!!) Fantastic performance from one radio.

\$10 freight anywhere  
in Australia.



**12 \*  
band  
GREAT  
VALUE  
only  
\$349**

### TEST EQUIPMENT

#### EA dual tracking P/S



Extremely versatile power supply:  
Will give plus & minus 1.3V to 22V  
at up to 2 amps PLUS A FIXED  
+5V@0.9A. The supply is completely  
protected against short circuits,  
overloads and thermal runaway.  
A large meter with voltage calibration  
is supplied as well as IC sockets. A quality kit.

**\$84.50**

Ref. EA March '82

#### Digital Storage CRO Adaptor \$110



Not only can you avoid buying an expensive CRO but you can have the features of the REALLY expensive ones!! \*Can display very slow waveforms \* One shot triggering \* Inbuilt graticule shows on TV screen \* Crystal locked timebase \* DC-100kHz bandwidth \* Capable of storage operations. Ref. Feb 1982 EA

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### GOOD-BYE 3002



**\$489** **\$399**

This 2x300W RMS P.A. Head is a classic road amp. Ruggedly constructed, 19" rack mount makes an ideal main P.A. or foldback unit. Great for Disco use as well.

We are discontinuing this amp because it is becoming too expensive to make. The metalwork costs alone now account for well over 50% of the unit. Because of this we have reluctantly decided to discontinue the unit. You can grab one now while they last for only \$399

Send SAE for  
full spec. sheet.



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ALTRONICS ... ALTRONICS ... ALTRONICS ... ALTRONICS ...

# I'M BUILDING *have built* THE FIRST TWO

- what am I raving about? Well, having one of the World's finest home stereo systems (the brilliant ETI 5000 series amp and preamp together with my beloved B & W DM II loudspeakers of course!), I couldn't resist building ETI's 5000 series 1/3 octave Graphic Equalizers. I have been pestering ETI for well over a year - and at last the many 1000's of 5000 series owners have the opportunity to complete their system with another classic, no compromise DAVID TILBROOK DESIGN. Details are on the other page of this ad.

Cheers... *Jack O'Donnell*

## DIGITAL FREQUENCY METER

See Electronics Aust. Mag. Dec. 81-Feb. '82  
500 MHZ, 7 DIGIT RESOLUTION PLUS  
PERIOD MEASUREMENT FEATURE



### IMPORTANT NOTES:

(1) This project is well within the scope of the "not so experienced" as virtually all components are contained on a single PCB.  
(2) **ALTRONICS USE ONLY THE SPECIFIED INTERSIC LSI** — BEWARE OF INFERIOR KITS THAT DO NOT CONFORM TO THE ORIGINAL DESIGN.

\* Screened front panel \* Bright high efficiency 7 segment display \* Frequency ranges 0-10MHz, 0-50MHz, 10-50MHz (with optional pre-scaler) \* 4 gating times — 0.1, 1, 10 seconds, \* 4 period measuring ranges 1, 10, 100 and 1000 input cycles give 0.1μs resolution. \* High input sensitivity — 10mV to 30MHz, 100mV at 50MHz @ 1M input impedance, 200mV at 500MHz @ 75 ohms input impedance. \* High accuracy — typically better than .005% count uncalibrated.

Costs a fraction of commercial counters.

**EXCLUSIVE ALTRONICS KIT FEATURES:**  
\* IC sockets provided throughout.  
\* Low aging 10,000 MHz XTAL.  
\* Thermallyo heatsink for 5V regulator.  
\* Quality Pactec Instrument Case

K 2500 (50 MHz version) ..... \$119.50  
K 2501 Pre-scaler ..... \$26.00  
(add for 500 MHz version)

## \* THE EVER POPULAR \* MUSICOLOUR IV EA PROJECT



Combination Colour Organ and Light Chaser. Four channel colour organ. Internal microphone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned.) Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc.  
K 1004 ..... \$79.50

## TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION



Petrol \$2.00 a gallon — Good Grief!

Yes, it's bad enough paying \$2.00 a gallon for petrol without waisting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop. Easy to build!

K 1010 ..... \$35.00

## FUNCTION GENERATOR WITH DIGITAL DISPLAY

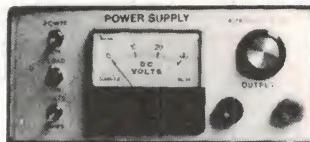


EA's new Function Generator covers the frequency range from 15Hz to 170kHz in three ranges with coarse and fine frequency controls. An economical 4-digit display has been incorporated to eliminate dial calibration. Sine wave distortion can be trimmed to around 0.5%. See EA April, 1982

K 2505 ..... \$85.00

## ALTRONICS POWER SUPPLY

BASED ON EA LM 317K PROJECT  
Every workshop, school and hobbyist  
should get one now!



\* Overload and short circuit protected.  
\* Full voltage and current metering.  
\* 3-32 volt output at 1 AMP.  
\* Uses LM 317K variable regulator.  
\* Full instructions and every last part included.

### VALUE PLUS!

K 3200 ..... \$39.95



## DIGITAL CAPACITANCE METER

Electronics Australia Project. Measures 1PF — 99.99 UF. 240V Mains Powered. Bright LED Display. Easy to build. Complete kit of parts and full instructions.

**\*\*\* EXCLUSIVE TO ALTRONICS \*\*\***  
Each kit now includes precision measured capacitors for accurate calibration of each range.

K 2520 ..... \$45.00

## DUAL TRACKING POWER SUPPLY



\$86.00

+ 1.3 to + 22V @ 2 AMPS + 5V @ 0.9 AMPS

Unit is fully protected against short circuits, overloads and thermal runaway. Pos and Neg supplies track within 1MV, voltage adjustable to within 10MV.

\* Uses .25% linearity 10 turn pot.  
\* High sensitivity meter.  
Essential for every school, workshop and lab.  
Easy to build!

K 2507 ..... \$86.00  
See Electronics Australia March 1982

## GREAT NEW MOSFET PA AMPLIFIER KIT FROM ETI 150 watts power output

See June '82



### UNCONDITIONALLY STABLE - SOUND STUDIO SPECIFICATIONS

OUTPUT IMPEDANCE Selectable to low Z

voice coil or 100V or 70V line out.

INPUTS 2 mic inputs Hi or low Z with

speech filter.

1 Aux. input.

\* Low noise 5534 op amps used.

\* Noble W/wound power resistors used in

output stage for guaranteed stability.

**\*\*\* ALTRONICS EXCLUSIVE \*\*\***

All due respects to ETI, but we felt the original case was lousy — So we've brought out ours utilising our snazzy H 0400 Black

Rack Cabinet.

It looks terrific!! And for this month only,  
it's the same price as the original version.

K 5035 ..... ONLY \$239.00

## GO ANYWHERE 240V PWR. KITS

See EA May and June '82. These great new inverter kits enable you to power 240V appliances for your car, caravan or boat. (From Standard 12V car battery.)

### 40 WATT

Suits small appliances, i.e. turntable, tape deck, shaver etc. Variable frequency adjustment enables accurate speed control of turntable motors.



IC Sockets Provided

K 6700 ..... \$55.00

### 300 WATT

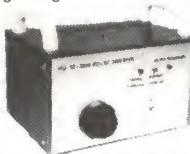
Fully regulated and overload protected  
XTAL locked frequency.

\*\*\*\*\*

## NOW USING HIGH EFFICIENCY C-CORE TRANSFORMER

\*\*\*\*\*

Use to power hi-fi, TV sets and for  
emergency lighting.



\* Gold plating on both PCB edge and edge connector.  
\* Low age rate parallel resonant XTAL used.  
\* Sockets for all IC's.

K 6750 ..... \$199.50

**\$10 DELIVERY ANYWHERE  
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## ALTRONICS GUARANTEE

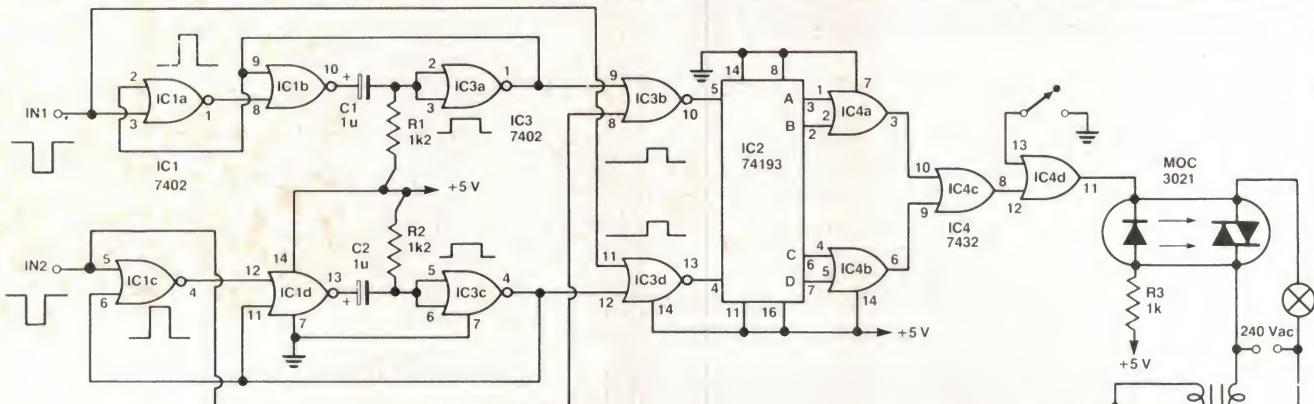
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ALTRONICS delivers faster!

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# Ideas for Experimenters



## Cunning light controller

This circuit can be used to switch a light on or off as a person walks in or out of a room. If two sensors are arranged either side of a doorway (infrared trip switches, like the ETI-570 from Jan. '82, for example) they can drive the two inputs to this circuit, IN1 and IN2. You could also use pressure mats, like those used with burglar alarms.

When IN1 is activated as you start to walk through the doorway (low-going pulse), IN2 is disabled. The IN1 pulse is stretched such that the output of IC3a is still high when IN2 receives a pulse as you pass through the doorway. The two pulses are fed into an up/down counter, IC2, IN1 driving the UP inputs, IN2 the DOWN input. The counter will count up

if IN1 is activated first, down if IN2 is activated first.

When IC2's outputs are all low, IC4 decodes this and switches off the light via the optocoupled triac. A switch is added on the final output gate, IC4d, so that you can manually control the light. Alternatively, pin 13 of IC4 could be driven from some other logic-level source for additional control of the light (from a sound, source, etc).

To set the time allowable to pass the two sensors,  $0.8 \times R1 \times C1$  gives the period. Note that  $R1 = R2$ ,  $C1 = C2$ .

There should be not more than 15 people in the room as the counter resets after this count and the lights will go off unexpectedly.

## 'IDEA OF THE MONTH' CONTEST

Scope Laboratories, who manufacture and distribute soldering irons and accessory tools, have offered to sponsor a contest with a prize to be given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI. Each month we will be giving away a Scope Panavise pc board holder, model 333 — as described in News Digest, p.8, October '81 issue. Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, worth about \$70, each winner will be paid \$10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

### RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Scope Laboratories, Murray Publishing, Offset Alpine, Australian Consolidated Press and/or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

The winning entry will be judged by the Editor of ETI, whose decision will be final. No correspondence can be entered into regarding the decision.



Winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI.

Contestants must enter their names and address where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

By decoding the outputs of the counter and displaying the result, you could externally monitor how many people are in the room. Next step is to put these switches all over the house, connecting the counter outputs to your computer, and have your computer keep track of you!

The same circuit could be used to control an electrically-operated 'pet door'. You could put the sensors at a suitable height or in a suitable place and regulate what animals are allowed in or out, e.g: let in the cat, keep out the dog, let in the wombat but keep the baby out. (Now that will require some ingenuity! — Ed.)

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

### COUPON

"I agree to the above terms and grant Electronics Today International all rights to publish my idea in ETI Magazine or other publications produced by them. I declare that the attached idea is my own original material, that it has not previously been published and that its publication does not violate any other copyright".

\* Breach of copyright is now a criminal offence.

Title of idea .....

Signature .....

Name .....

Date .....

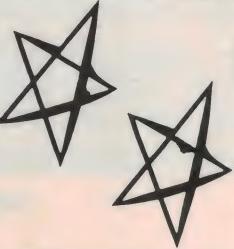
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Postcode .....

Cut out and send to: Scope/ETI 'Idea of the Month' Contest, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

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BREAKTHROUGH!**

# CAR COMPUTER BELOW \$200



COMPLETELY BUILT  
AND TESTED —  
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MADE  
IN ENGLAND!  
— QUALITY!!

See Review  
ETI  
This issue  
Pgs 26-27.

SEE REVIEW  
OCTOBER EA  
PAGES: 26,27,28.

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LSI CHIP TO ACHIEVE  
LOW PRICE

only  
**\$199**  
complete

Never before has such a comprehensive car performance computer been offered at such a low price!! Once again miracle microprocessor technology has enabled us to pass enormous savings on to you!! But don't let the low cost fool you. The "Voyager" car computer IS THE MOST COMPREHENSIVE PRODUCT THAT WE HAVE SEEN. No other car computer matches this one AT EVEN TWICE THE PRICE!! You could buy a \$20,000 Holden and not get a better car computer!! Just check the features. We are sure that you will calculate that the "Voyager" represents outstanding value!

## FEATURES

- INSTANT FUEL CONSUMPTION IN LITRES/100KM AND MPG!! (MOST OTHERS HAVE ONLY ONE OF THE ABOVE) JUST SWITCH FROM ONE TO THE OTHER AS YOU DRIVE ALONG.
- INSTANT SPEED, TIME AND OTHER FUEL DATA.
- VISUAL AND AUDIBLE EXCESS SPEED ALARM.

## INSTALLATION

The "Voyager" comes complete with an unbelievable array of mounting configurations, on dash, under dash or stalk mount. ALL installation hardware is supplied (even a roll of insulation tape!) as well, of course, as the speed and fuel sensors. A lavishly illustrated installation manual is provided as well as a comprehensive operators manual. If you do not want to install the unit yourself we can do this for you for a guaranteed \$39.50\*. (A few exotic cars excluded!). A typically competent EA/ETI reader would do the job in 3-4 hours.

\* Sydney metropolitan area only.

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\$100 up (\$6.20)	

# LOOK! More books!

Mail order coupon on page 99.

## ELECTRONIC TIMER PROJECTS

**BP93**

**\$6.56**

These may have a high degree of accuracy with quartz control or they may be quite simple designs, using only a few components. A number of specialist timer projects are car windscreen wiper delay unit, darkroom timer, metronome etc.

## ELECTRONIC PROJECTS FOR CARS AND BOATS

**BP94**

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Fifteen fairly simple projects designed for use with 12 V electrical systems but in some cases can also be employed with 6 V and/or positive earth systems as well.

## MODEL RAILWAY PROJECTS

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Projects include such things as controllers, signals and sound effects units. Construction stripboard layouts are provided for each project.

## CB PROJECTS

**BP96**

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A number of useful designs include a speech processor, interference filters and a simple CB radio receiver. Stripboard layouts, wiring diagrams and notes on construction are provided.

## POPULAR ELECTRONICS CIRCUITS — BOOK 2

**BP98**

**\$7.52**

A companion for BP80, this book provides a wide range of designs for electronics enthusiasts who are capable of producing working projects from just a circuit diagram without the aid of detailed constructional information.

## MINI-MATRIX BOARD PROJECTS

**BP99**

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This book provides a selection of 20 useful circuits which can all be built on a mini-matrix board which is just 24 holes by 10 copper strips in size. Simple and easy for those with not much experience in electronics.

## MULTI-CIRCUIT BOARD PROJECTS

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All circuits are based on one specially designed pc board. Recommended to the less experienced hobbyist.

## ELECTRONIC SCIENCE PROJECTS

**BP104**

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These projects range in complexity from a simple colour temperature meter to an infra-red laser. There is an electronic clock regulated by a resonating spring and an oscilloscope with a solid-state display. How to build them and use them is fully explained.

## AERIAL PROJECTS

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Practical aerial designs including active, loop and ferrite which are relatively simple and inexpensive to build. The complex theory and mathematics of aerial design have been avoided.

## MODERN OP-AMP CIRCUITS

**BP106**

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A collection of widely varying circuits and projects based on the op-amp ICs.

## HOW TO GET YOUR ELECTRONIC PROJECTS WORKING

**BP110**

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Helps you to overcome the problems of a circuit that doesn't work by indicating how and where to start looking for many of the common faults that can occur when building up a project.

## circuit techniques and design

### TTL COOKBOOK

**21035P**

**\$17.50**

A complete look at TTL logic circuits — what TTL is, how it works, and how to use it. Many kinds of practical TTL are included, such as digital counters, electronic stopwatches, digital voltmeters, etc.

### ACTIVE-FILTER COOKBOOK

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Learn how to construct filters of all kinds — highpass, lowpass, bandpass. The book is easy to understand — no advanced maths or obscure theory is used.

## ELECTRONIC CIRCUITBOOK 1: PROJECT CONSTRUCTION

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*continued on page 88*

# LETTERS

**Dear Sir,**

I am writing to advise you of a mistake on page 61 of the Ideas for Experimenters section of the July 1982 issue of ETI. You summarised a brief article I wrote for the SAMG newsletter but unfortunately printed the wrong circuit diagram with the text. For your information, the history is as follows.

J. Wilson's interlace modification in your June 1981 issue contained a mistake which prevented the modification working.

E. Clarke (SMAG newsletter, Oct/Nov 81), whom you also mentioned in your July 1982 issue, couldn't get that modification to work (because of your printing error) so he designed a modification to perform the same function using several packages.

I then wrote the article (SAMG newsletter Dec 81/Jan 82) which you saw, providing a correction of your misprint of June 1981. I provided no circuit because it was a simple modification which worked well.

The circuit diagram which you printed was for a modification I described in the same issue of SAMG newsletter, detailing how to get the PCG (ETI-681) joysticks to work with a CPU running at 4 MHz.

**N.J. Phillis  
Salisbury SA**

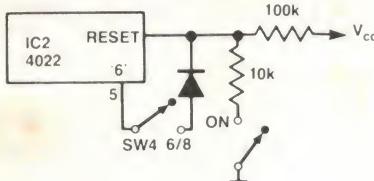
**Dear Sir,**

I am interested in the percussion synthesiser and the sequencer projects which have appeared in ETI this year and, funds permitting, I hope to build them.

However it seems to me that there is a basic deficiency in the sequencer project (ETI June 82). At the bottom of page 67 you state, "For example, closing switches 1, 3 and 4 will generate a waltz rhythm". This seems to indicate a lack of understanding about waltzes and is a shortcoming in the circuit. As far as I know, waltzes are almost always in 3/4 time i.e.: there are three beats to the bar (or six half beats).

Therefore, it is not possible to produce a waltz rhythm, or anything in 3/4 or 6/8 time since the sequencer always works

on a sequence of eight beats. But this is easy to fix as the diagram below shows.



Only SW4, one diode and the 10k resistor are needed to modify the unit. Closing SW4 connects output '6' via the diode to the reset input. When the counter counts to '6' (i.e. on the seventh beat) a pulse is sent to the reset input, resetting the counter to zero, and the counter starts again. The 10k allows the ON switch to function without interfering with the reset action for 6/8.

This method is simple and doesn't require many parts. I have tried this out on a Proto Board and it seems to work without any problems. With this, or a similar modification, the unit will now be able to play waltzes.

If you had used a 4017 it would be possible to get a 5/8 beat as well. I am somewhat surprised at your apparent lack of knowledge, or misunderstanding of what is required.

All that aside, the project looks good.

**Phil Dennis  
Chippendale NSW**

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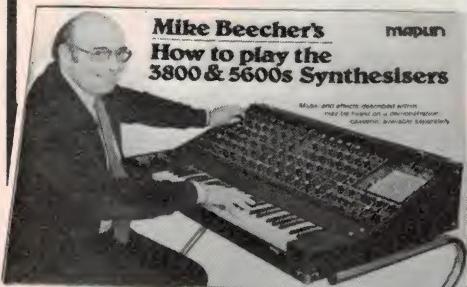
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See EA Nov 82. **\$39.50.**



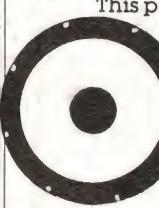
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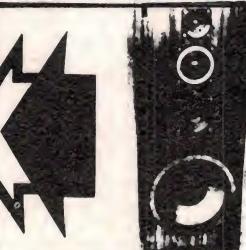
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Absolutely complete kit which includes pre punched chassis, all IC sockets, metal film resistors, and all the quality components you would expect from an Electronic Agencies kit.

See ETI Nov 82.

KE5060 **\$199.00**  
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# Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.

## Series 5000 Graphic equaliser

Because the Series 5000 equipment is so phenomenally popular, this project will be widely stocked as a kit. Any supplier advertising Series 5000 equipment in the past will have this project in stock. If you're a mechanical masochist and really *have* to cut all 28 slots in the front panel by hand then we sincerely wish you all success. From experience, we know most hobbyists don't fit this category and will be seeking kits. At press time, we knew the following firms were to stock the project: Electronic Agencies and Jaycar in Sydney, Rod Irving Electronics in Melbourne and Altronics in Perth. These firms will be able to supply complete kits, right down to the last nut and bolt and featuring silk-screened front panels.

## ETI-165 Tacho calibrator

So far as we are aware, only Rod Irving Electronics are stocking this project as a kit. Save yourself the trouble of hunting up all the components and contact them for a kit.

If you have some of the components on hand for this project and want to shop around for the rest then you should find most available almost anywhere. The BD266 Darlington used to drive the loop is not too common, but you should find it at David Reid and Jaycar in Sydney, or Magraths and Ellistratics in Melbourne, plus Data Parts in Shepparton (for Victorian country readers).

The EC.1001 case is manufactured by Sigea in Melbourne. If you cannot find a local supplier, they can be contacted at P.O. Box 49, Thornbury Vic. 3071.

The PL24/5VA Ferguson pc-mount transformer is available from Jaycar in Sydney and Rod Irving Electronics in Melbourne.

Printed circuit boards and Scotchcal front panels may be obtained from the suppliers listed in Shoparound in the August issue this year (page 70).

## ETI-653 16 Channel computer output driver

Kits for this project will be stocked by Electronic Agencies in Sydney and Rod Irving Electronics in Melbourne as well as Dick Smith Electronics all over the country.

For those who have parts on hand, then pc boards can be obtained from the suppliers listed in Shoparound in the August issue this year (page 70).



Latest addition to the line of tools produced by Minitools is the 'Gravilo' engraving tool. Like all other Minitool tools it is powered from 12 Vdc. The engraving bit spins at 18 000 rpm and the whole unit weighs just 60 grams. Details from Minitool Australia, 134A Ayr St, Doncaster 3108. (03)850-9887.

For those wanting to make their own pc board, a print of the full-sized artwork can be obtained by sending a stamped, self-addressed A4-sized envelope to:

ETI-653 pc board artwork  
ETI Magazine  
15 Boundary St  
Rushcutters Bay NSW 2011

## Address missing

The fairies at the bottom of the darkroom had an insatiable appetite last month, and not content with chewing up leftover artwork, attacked page 64 and devoured the address on A.E.D.'s advertisement at the top of the page. If you want to find out more about the Little Big Board advertised there, contact A.E.D. at 130 Military Rd, Guildford NSW 2161. (02)681-4966. Tell them the fairies sent you. ●

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A machine vice is included with both models.

Mini Drill I	\$165
Mini Drill IH	\$165

For brochures, prices and information contact

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Mechanically rugged the SX-200 uses high quality double-side Epoxy-Glass printed circuit boards throughout. Some of its other outstanding features include 3 MODE SQUELCH circuitry which allows the lockout of spurious and carrier only signals, extremely low spurious count, AM and FM detection on all bands, FINE TUNING control for off channel stations, 240 VAC on 12 Volt DC operation, Accurate QUARTZ CLOCK, Squelch operated OUTPUT for switching a tape recorder etc, 16 Memory channels, MEMORY BACKUP which lasts up to two years, high SENSITIVITY and SIGNAL-TO-NOISE ratio on all bands, CRYSTAL FILTER for excellent SELECTIVITY and easy servicability due to component layout as well as a 90 day warranty.

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### GFS Electronic Imports

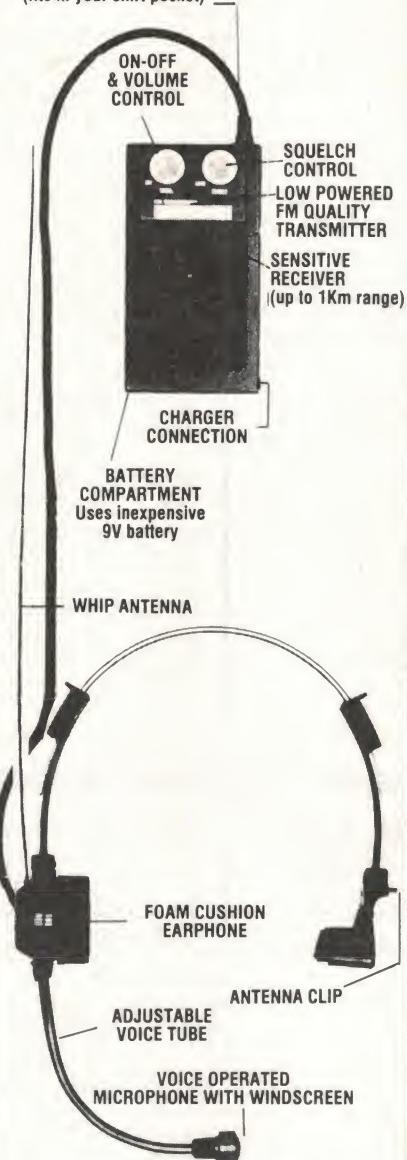
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# COMMUNICATIONS

## Amateur transponders for geostationary satellite?

Two geostationary amateur satellite transponders may become a reality by the end of 1985 if a proposal by the President of Cablesat General Corporation of Cocoa, Florida USA, is put into effect.

**The President of Cablesat, Ray Kassis WA40HK, has proposed a 'no-strings' gift of two transponders to be carried aboard the 'Cablesat East' satellite to be orbited by the company in 1985.**

The two 10 MHz-wide transponders will be part of a pair of 24-channel communication satellites and the value of the gift is estimated to be in the vicinity of US\$20 million.

The transponders will operate in C-band, adjacent to an existing amateur microwave band. The overall proposal has been submitted to the FCC for action and, if approved, will give amateur radio the kind of communications only dreamed about in the past.

Ray Kassis would like to see formation of an amateur radio experimental network dubbed ARNET, with a proposed uplink frequency of 5.65-5.67 GHz and a downlink in the C-Band at or near 3.40-3.41 GHz.

It is estimated that amateurs using a 6 foot dish and 10 watts of power (or less) will provide sufficient voice communications performance over the transponders. According to Cablesat General, the transponders will use circularly polarised antennas

to provide as large a 'footprint' on the earth's surface as is possible, unlike the other 23 transponders on each bird whose signals will be beamed to specific geographic areas.

With satellites at either end of the equatorial 'geostationary parking orbit', the Eastern bird will not only cover most of the continental USA and Canada, but will also serve Central and South America as well.

The Western bird will have similar Northern hemisphere coverage and will reach well out into the Pacific to include the Hawaiian Islands. It is not known if coverage will reach Australia.

Kassis has placed the operation of these transponders with the ARRL, but said that one of the things that he would personally like to see is some form of amateur radio emergency network, possibly one using either computer-based or packet radio technology.

He envisions a new era in amateur radio experimentation using the satellites, and hopes that this gift may add impetus toward getting new, technically-minded people into amateur radio, and possibly from there into careers in the sciences and technologies. (Westlink Report.)



### Reading the RTTY, a breeze with Telereader

**Those myriad of 'warble' signals heard all over the shortwave bands are a variety of radioteletype, morse and ASCII (computer) communications signals. With the Telereader model CWR-670E you can decipher them all.**

The CWR-670E is a converter that attaches to the audio output of any receiver and will convert morse (CW), radioteletype (RTTY) and ASCII signals to a composite video output that can be viewed on a suitable monitor or TV set. A Centronics parallel printer interface is also provided if you want hard copy output from one of the standard computer printers.

ETI recently had the opportunity of using a Telereader CWR-670E and a companion video monitor, model TMC-9M. The Telereader can be set to demodulate morse ranging in speed from 4 wpm to 50 wpm. The RTTY demodulator can convert the IARU and US tone standards in three shift widths of 170 Hz, 425 Hz and 850 Hz. Reverse shift can be copied too. Maximum speed that can be accommodated is 110 baud.

The display memory gives you 14 lines of 75 characters per line on the video output, 16 lines of 36 characters per line on a printer. A useful CW practice function is provided so that you can plug in a key and display your efforts on the

monitor or your TV set. In addition, a CRO output is provided giving a cross pattern for tuning purposes. Very handy. A mark-space LED indicator on the front panel is used in lieu of CRO tuning.

We connected the Telereader converter input to the AUX SPEAKER output of a Yaesu FRG-7 general coverage receiver, rigged up a hasty antenna ('random wire') and tuned around for some likely signals. Lo and behold!, we found plenty of interest — indecipherable message code a lot of it, but some intelligible news services could be found. The unit performed faultlessly on both CW and RTTY and would cleanly 'copy' signals that didn't even move the receiver's S-meter.

General operation is 'a breeze' and all controls function as you'd expect them to. If you want to explore a whole new world on shortwave, or get into amateur radio tele-type etc, this looks a good place to start. Starting price is \$447 for the model CWR-670E. Further details from Emtronics, 649 George St, Sydney NSW 2000. (02)211-0531.

### Field day in the Blue Mountains

**The Blue Mountains Amateur Radio Club will hold their annual field day on November 14 at Springwood High School, Chapman Parade, Springwood.**

All the favourite field day events will be on for young and old: HF/VHF scramble, 'sniffer' transmitter hunts, the traditional 'fox' hunts, etc.

There will be a number of trade displays and that old favourite — the auction, where you can off-load all that junk you bought at another club's auction last year!

If you're taking your family, and they'd rather go sightseeing, there's the Norman Lindsay gallery and museum just down the road from the field day venue and plenty of other local sights.

Don't forget, November 14, at Springwood. The fun commences at 0900 (EADST).

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## Beeforth On Oscilloscopes



If you have anything to do with electronics then I bet you can't think of many jobs where an oscilloscope isn't useful. I guess it all comes about from the old adage 'a picture is worth a thousand words'. Now, in less than a thousand words, I'll put you in the picture regarding TRIO's CS-1560All oscilloscope.

The 1560All is a dual trace, 15MHz, honest-to-goodness value for dollar instrument. It is well suited to industrial applications, TV servicing, production line testing, educational or hobby work. It is rugged, reliable, easy to use and very portable. Vertical sensitivity is good without sacrificing large signal input capability. Sweep rates are from a high 0.5μS to 0.5S per division and a high persistence P7 Phosphor is now available as an option to make full use of the slowest ranges.

Triggering can be normal or via a video sync separator and has to be the best in any low-cost oscilloscope ever made. How often have you used a big name, high performance oscilloscope for routine work and been driven mad by the constant fiddling needed to maintain a stable triggered display particularly when the input is variable. With one wave of a CS-1560All the problem vanishes. Up to its rated 3db point of 15MHz it will produce a locked display with only 0.2 of a division deflection amplitude. At 20MHz it requires only 0.3 of a division to lock and at 25MHz, 0.7 of a division. That is real triggering!

Along with the rest of TRIO's range, this instrument is slanted toward useability, the kind of convenience and practicability that makes you reach past the 'Gee wizz technoscope' to grab the little TRIO with the sharp, stable, bright blue trace that shows the whole picture quicker than I can tell it.

The best way to see why I'm so keen on the CS-1560All is to check it out for yourself at any Parameters location or stockist right throughout Australia.



Trade Enquiries: Sydney (02) 439 3288  
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2SC536	1.10	.49	2SC1675	.75	.39
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2SC733	.70	.39	2SD525	3.60	1.35
2SC735	1.05	.45	2SK19	1.50	.89
2SC768	.80	.45	AN214	5.40	2.95
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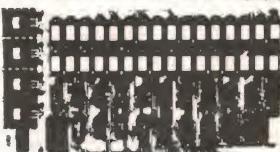
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7 72 Pin IC's - ALL pins functional  
8 PHANTOM is jumpered to PIN 67  
9 LOW POWER under 1.5 amps TYPICAL from 5v & 8v Buss  
10 Blank Board can be populated as any multiple of 4K.

BLANK PC BOARD W DATA \$59.50  
LOW PROFILE SOCKET SET \$22  
SUPPORT IC'S & CAPS \$29  
ASSEMBLED & TESTED ADD \$30

OUR #1 SELLING  
RAM BOARD!

### S100 COMPUTER PRODUCTS

#### 32K S-100 EPROM CARD

**NEW!**



**\$99.95**

KIT  
USES 2716's  
Blank PC Board - \$59  
ASSEMBLED & TESTED  
ADD \$30

**SPECIAL: 2716 EPROM's (450 NS) Are \$5.90 EA. With Above Kit.**

KIT FEATURES:  
1 Uses +5V only 2716 (2Kx8)  
2 Allows up to 32K of software on line!  
3 S-100 Compatible  
4 Addressable by two independent 16K blocks  
5 Cromemco extended or Northstar bank select  
6 On board wait state circuitry if needed

7 Any or all EPROM locations can be disabled  
8 Double sided PC board solder-masked, silk screened  
9 Gold plated contact fingers  
10 Unselected EPROM's are automatically powered down for low power.  
11 Fully buffered and bypassed  
12 Easy and quick to assemble

\* \* \* AVAILABLE AGAIN \* \* \*



16K Dynamic Ram Board  
• Fully Expandable to 64K  
• Assembled, tested and guaranteed  
• S100 Compatible

16K Dynamic RAM Board assembled and tested:  
Special \$269 plus tax (4MHz) \$299 plus tax (4MHz)

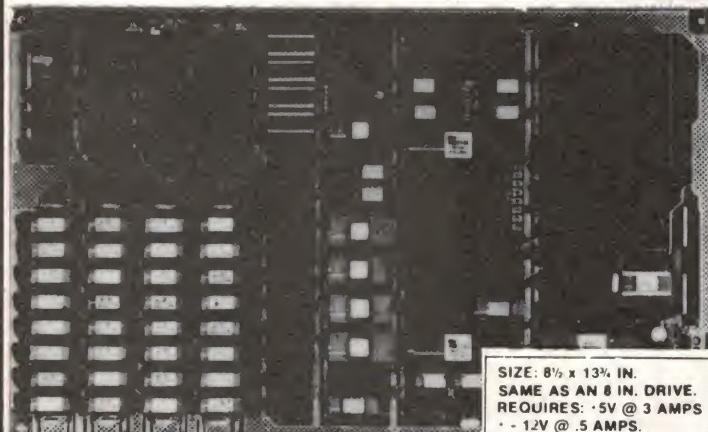
This must be the best offer available on quality tested dynamic RAM boards.

32K Assembled and tested \$289 plus tax (4MHz)

48K Assembled and tested \$309 plus tax (4MHz)

64K Assembled and tested \$329 plus tax (4MHz)

## 64K SINGLE BOARD COMPUTER KIT NOW ONLY \$499 + TAX.



### 24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

### FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M® 2.2.

### FOUR PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O \$21

### PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M®, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. It does not occupy any of the 64K of system RAM!

ETI1178/4  
Please debit my Bankcard  
Bankcard No \_\_\_\_\_  
Expiry Date \_\_\_\_\_  
Name \_\_\_\_\_  
Signature \_\_\_\_\_

General enquiries (03) 489-8131. Mail order enquiries (03) 481-1436. Ritronics Wholesale (03) 489-7099. (Tax Exempt Enquiries)

Prices subject to change without notice. Send 60¢ and SAE for free Price lists. MAIL ORDERS PO BOX 235, NORTHCOTE, Vic. 3070. Minimum pack and post \$5.00. Telex AA38897.

PLEASE WRITE OR RING FOR THE BEST POSSIBLE PRICES ON DISC DRIVES, PRINTERS AND OTHER COMPUTER COMPONENTS.

## SINGLE BOARD COMPUTER KIT NOW ONLY \$475 Including tax (\$435 tax exempt)

Also available: Blank PCB's with ROMs \$275 + Tax. Assembled & Tested \$599 inc. tax.

**THE FERGUSON PROJECT:** Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M®. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, and an enclosure, and you have a total Business System for about 1/3 the cost you might expect to pay.

**FEATURES: (Remember, all this on one board!)**

### 64K RAM

Uses industry standard 4116 RAM's. All 64K is available to the user. Our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PCB layout to eliminate potential noise and glitches.

### Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software

### SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 int. Price for all parts and connectors: \$49

### BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display

### REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: \$15

# COMPUTING TODAY

## Open systems local area networks



### Tandy's new TRS-80 Model 16 microcomputer

At the heart of the Model 16 is an MC68000 microprocessor, a 16/32-bit CPU. The Model 16's second microprocessor, a Z-80A, handles I/O functions. This dual processor design permits the Model 16 to operate as a Model II and use existing Model II software.

The Model 16 is capable of 512K internal RAM memory storage and 2.5M of disk memory using two all-new built-in 'thin line' double-sided 203 mm disk drives. Additional external disk storage to over 33M may also be added via TRS-80 hard disks.

The Model 16 is equipped with two RS232C serial interface ports and a parallel interface port. One of its serial ports is capable of bisynchronous communications to IBM and other mainframes.

### Digital psychiatrist interviews you on the couch

Dreamcards, a Melbourne software supplier, has released a new program called 'Psychotec' that turns the personal computer into a tame psychiatrist.

Written for the new 'Microbee' computer (but with full conversion instructions for any other 16K BASIC system), the program allows a dialogue between operator and computer in the style of a psychiatric interview.

The program is supplied as a booklet which contains a full expanded listing, detailed instructions for conversion to other BASICS and a complete and easily understood description of the program logic, to

allow it to be modified as desired. The detailed analysis in the program booklet allows the reader to readily comprehend how BASIC routines can be used to process and understand the English language for all sorts of applications.

Available from Dreamcards, 8 Highland Court, North Eltham Vic. 3095, the program is \$20 and a cassette dump (Microbee format) is \$5 extra. Send SSAE to Dreamcards for further information.

In a major step towards true open systems interconnection and networking between equipment supplied by different manufacturers, a number of companies recently announced their support for a set of local area network standards.

**The companies are:** Intel, ICL, Siemens, Nixdorf, CII-Honeywell/Bull, Fujitsu, DEC, Three Rivers Corp, Mitel Corp, Logica-VTS, Olteco/Olivetti, L.M. Ericsson, Ungerma-Bass Inc, 3-COM Corp, Hewlett Packard, Xerox, Information Technology Ltd, Network Technology Ltd, Computer Technology Ltd and Office Technology Ltd.

All these companies support the ISO transport protocol Class 4 (ISODPSC16N699) for the transport layer which is international standardisation of prior ECMA work. (ECMA '72 revised.) For the lower layers they will support the new ECMA standard for the physical and data link layers (No. 80, 81, 82) for CSMA/CD local area networks. The standardisation of these three protocols will represent a major step to intervendor networking and benefit both users and manu-

facturers of computing equipment.

At the physical and data link layer these ECMA standards are largely compatible with Ethernet in all major areas. The interfacing of such local area networks with the public networks would typically be achieved through X.25. It will be possible to integrate X.25 virtual services into such local area networks.

The development of these standards and continuing work within the ECMA community to define standards for networking is seen as a precursor to international standardisation.

These proposals from ECMA to ISO are submitted for consideration as input to international standards as are inputs from other national and international standards bodies. These companies are also working in close conjunction with their national and trade associations.

### It's so noisy I can't hear myself think

You'll know what I mean if you work in a noisy office and sometimes you feel that you just can't think straight . . . around corners maybe.

Well, Magmedia believe that they have the answer to your problems with their acoustic sound enclosures which have a thick acrylic lid and a base covered with acoustic carpet. Magmedia claim that their acoustic sound enclosures will effectively reduce noise levels, improving the environment in your office.

If you want to find out more contact Magmedia at 100 Park St, South Melbourne Vic. 3205. (03)699-9688.



### Intel and TI share project

Intel Corporation and Texas Instruments are exchanging masks and process information for the manufacture of an NMOS combination codec/filter IC designed for the telecommunications market. The 'combo' codec/filter is called the 2913/2914.

Late in 1981, TI and Intel agreed in principle to jointly manufacture and market the 2913/2914. TI will source the Intel-designed NMOS combos and Intel will have the option of

sourcing TI's future pin-compatible CMOS combo devices. Both versions incorporate a PCM and transmit/receive filter on chip.

# Meet the **MPU-100**

SME Systems know computers, we've been building them for years. And we know what the discerning computer buyer wants most of all — a Z80 system that will provide him flexibility, performance and reliability.

Flexibility to be configured to perform simple single user tasks, and capable of configuration for multi-terminals, color graphics, word processing, business accounting, process control and scientific work.

The MPU-100, the flagship of the SME Unicorn series, is designed around the industry standard S100 bus, with an advanced vertical motherboard system giving it the highest reliability and lowest profile of any commensurate system.

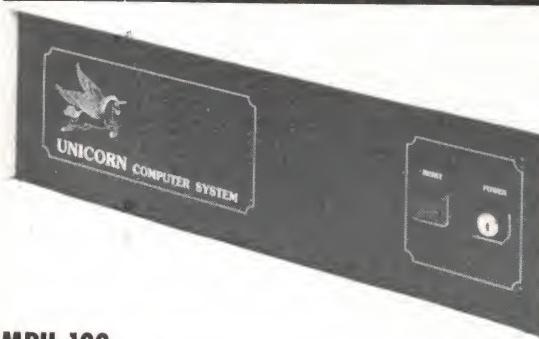
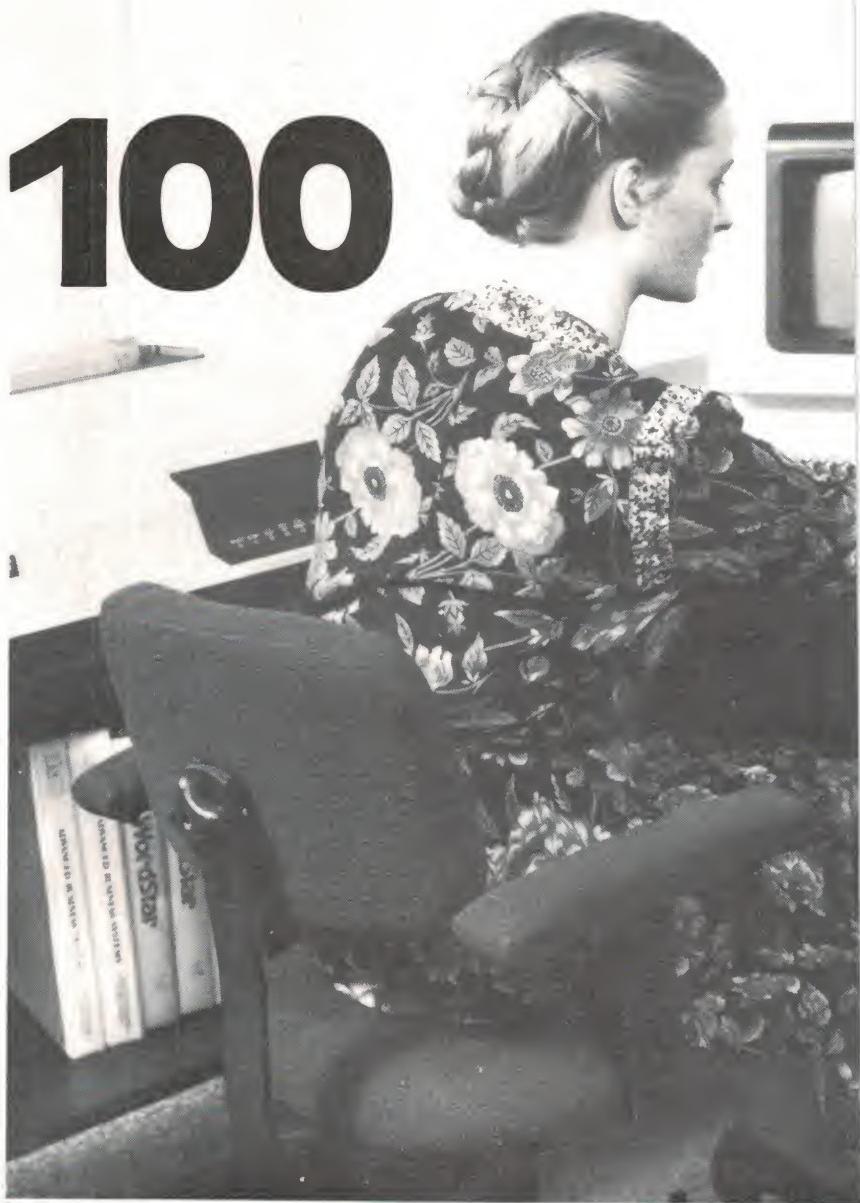
It is CPM based, and its attractively housed system looks equally well rack mounted or on the desk top.

The economically priced system can be configured with the basic MPU-100, its natural partner the DDU-8 2 Mbyte twin disk drive unit, terminal and printer.

Addition of the SME Dartbauds will allow a further 6 terminals or modems to be added, and a further card will allow it to handle up to 50 Mbytes of hard storage.

Other configurations could include one or more HDU-1001 10Mbyte Hard Drive/1Mbyte floppy subsystems, or the revolutionary 16/Mbyte Lark fixed/removable hard drive units.

Like the hundreds of SME systems already installed around Australia, the Unicorn series is built

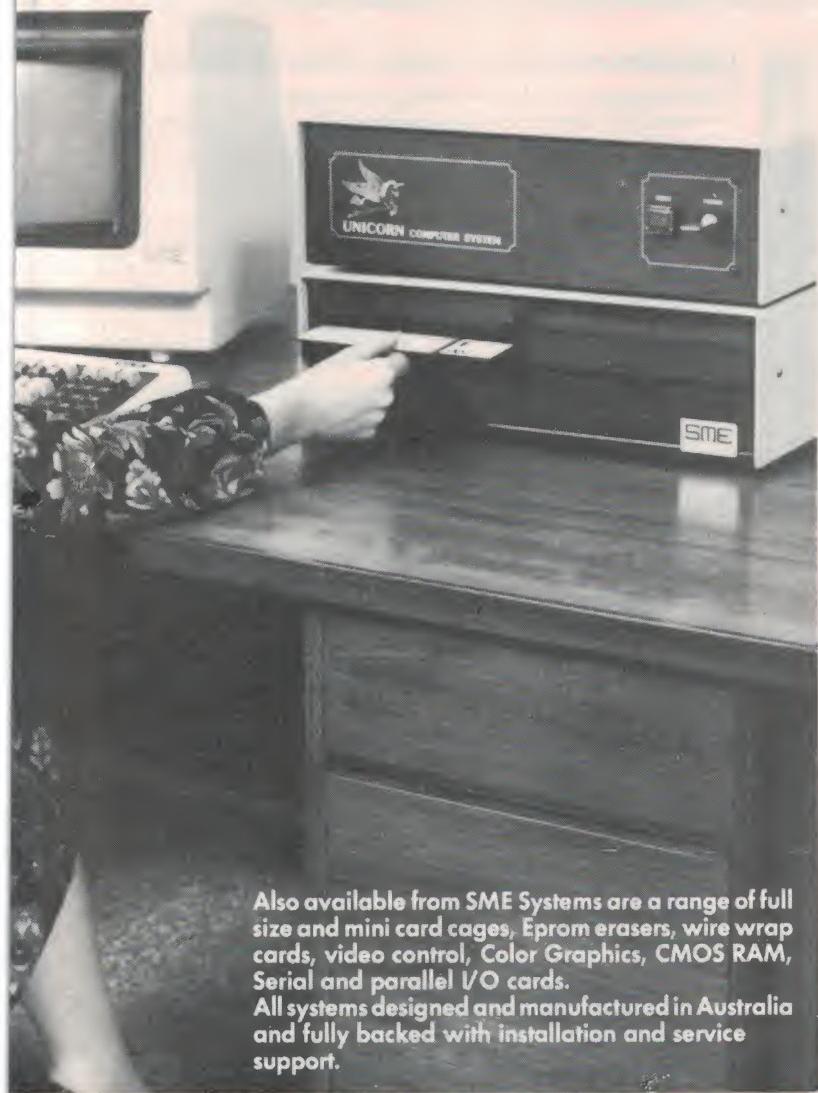


**MPU-100**



**DDU-8**

## The microcomputer for people performance, durability and



Also available from SME Systems are a range of full size and mini card cages, Eprom erasers, wire wrap cards, video control, Color Graphics, CMOS RAM, Serial and parallel I/O cards.  
All systems designed and manufactured in Australia and fully backed with installation and service support.

to stand up to everything that business, commerce, industry, and nature can put it to, and to continue operating without missing a beat.

Its modular construction allows for the easy addition of further function boards as they are required.

A wide range of interface cards such as Color graphics & CMOS RAM, make the MPU-100 one of the most versatile systems available today.

SME SYSTEMS build for strength, speed and reliability. All units can be bench mounted or fit comfortably in standard 19" rack configuration.

### **The expandable MPU-100**

This rugged, low profile system, has vertical 10-slot motherboard minimises transmission line defects. Core CPU is the versatile Z80, 4Mhz, SBC 800, the enhanced FDC-II floppy disk controller card, and the DRC-II state-of-the-art 64/256K dynamic RAM card.

### **The highly reliable DDU-8**

A low profile double/sided dual 8" disk drive unit with 2 Mbyte storage, door locking, internal fan and power supply. The perfect partner for the MPU-100.

### **The hard to fool HDU-1001**

Incorporates a 10 Mbyte mini-Winchester hard drive, and 1 Mbyte 8" floppy. Its DTC510 internal controller uses Bit Slice technology to achieve high data throughput, extensive error detection and correction. On board memory provides data buffering.

### **Backing up is a Lark**

The 16 Mbyte Lark Hard drive system fulfills the dream of data base owners. 8 Mbytes are on fixed disk, and 8 Mbytes on removable sealed cartridge — providing the ability to back up a full 8 Mbytes in 2 minutes. With its built-in back up and other features the Lark is less subject to failure than old style cartridge drives.



**HDU-1001**



**LARK**

**who want permanence,  
quality**

**SME  
SYSTEMS**

SME Systems, 22 Queen Street, Mitcham, Vic. 3132.  
Phone: (03) 874 3666. Telex 37213.

# Print-out



## Computerland contract to sell Sirius microcomputer

Barson Computers has won the contract with Computerland Australia for sale of the newly released Sirius 16-bit microcomputer through Computerland's national chain of fifteen stores.

Worth an estimated \$3 million in Sirius sales over the next twelve months, the contract was signed on August 3 in Computerland's new premises at 364 Sussex Street, Sydney by Computerland's managing director Lorna Hoess and Julian Barson, managing director of Barson Computers.

Retailing for \$5295 plus tax, the Sirius offers the user a 16-bit processor, 128K RAM, 1.2 Mbytes of floppy disk storage and an ultra-high resolution display. It has been designed for the small business and has a large library of applications software.

## Amber phosphor screens

The latest advance in the reduction of VDU operator eye strain is the adoption of amber or yellow VDU screens. This trend has accelerated dramatically in Europe in recent years.

Tubes with this phosphor are now being manufactured in Australia by Thomas Electronics in a variety of types including 9", 12" and 15" sizes.

A number of anti-glare treatments are also available. Tubes are manufactured to customer specifications, so that existing VDU's can be fitted with amber screens.

Very high resolution CRTS for applications such as Word Processors and Phototypesetting are included in the range.

For more information contact Thomas Electronics of Australia Pty Ltd, 12 Larkin St, Riverwood NSW 2210.

## AED releases new Superaed

AED Microcomputer Products announce the release of a new extended version of the Superaed CP/M extension package. The new package offers an extension of the features of the old version and a much greater flexibility to the user who wishes to modify the package for alternative or additional hardware.

AED are also making available a configure program called Supercon, similar in principal to that offered with Wordstar.

The new Superaed improvements are: keys default to issue any code or string of codes, keys can be dynamically defined as strings, con-

figurability of all hardware drivers, extended and improved monitor features, status line and control and configurability of desired options.

Enquiries to AED Microcomputer Products, 130 Military Rd, Guildford NSW 2161. (02)681-4966.

## Microcomputer grant from Digital

Digital Equipment Australia Pty Ltd has given an equipment grant valued at \$70 000 to the Queensland Institute of Technology.

Digital are seeking to enhance teaching and research in microelectronics and computing. To achieve this they have established a Special Equipment Grant Program with the intention of installing microelectronics research equipment in selected centres throughout Australia.

QIT was awarded the grant ahead of keen competition from Universities and Colleges specialising in microcomputing, based on its excellent submission which Digital

believed was an ideal application of microcomputer technology.

Some of the equipment will be located in QIT's Microprocessor Development Centre which is being established by QIT and several large Queensland industrial organisations. The aim of the Centre is to provide the latest microprocessor facilities for firms in the state. In particular, expertise will be provided to implement the latest technologies in industrial processes.

## Single chip IBM 3274/3276 compatible coax receiver/transmitter

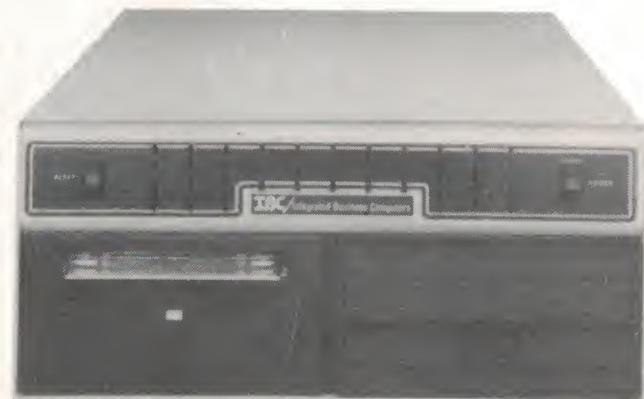
Standard Microsystems Corporation recently introduced the COM 9004 IBM 3274/3276 Compatible Coax Receiver/Transmitter. It is the first commercially available single chip metal-oxide-semiconductor/very-large-scale-integrated (MOS/VLSI) circuit IBM compatible receiver/transmitter, claim Standard Microsystems.

The COM 9004 is designed to allow simple implementation of high speed serial data communications. It is a serial encoder/decoder for interfacing any standard parallel microprocessor data bus to a bi-phase serial line. Besides the double buffered serial to parallel and parallel to serial converters, the COM 9004 provides a Manchester II bi-phase encoder and decoder,

parity detection and generation, and internal diagnostics for testing both itself and the line driver/line receiver circuitry.

It detects and generates line quiesce, code violation, sync, parity, and mini-code violation sequences specified by IBM.

For more information contact Total Electronics, 9 Harker St, Burwood Vic. 3125.

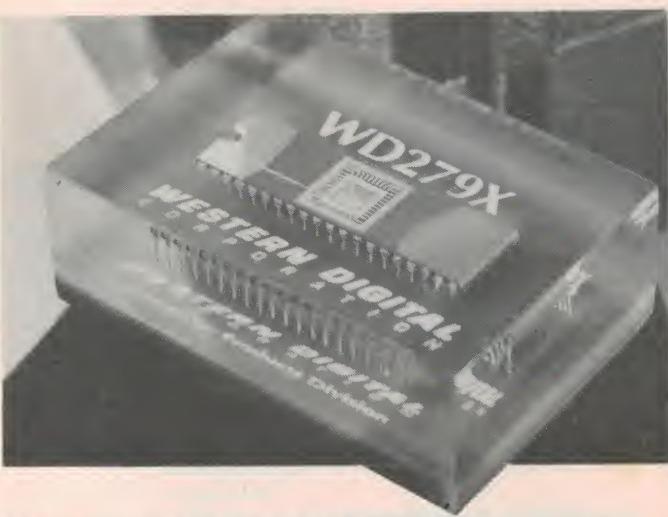


## IBC Super Cadet cache disk memory

IBC recently introduced a cache disk memory for the Super Cadet computer system. The memory consists of 256K of 150 ns, 64K RAM chips on a 102 mm square pc board.

IBC claim that with overlayed operating systems such as OASIS the cache disk offers the user a substantial increase in system performance, making it four times faster than its nearest competitor. Using block transfer, the 6 MHz, Z-80B can transfer a typical 5K

overlay into the main system memory in less than 18 ms. Using the cache disk to store all program overlays, frees the disk drive to do only transactional data I/O, thereby increasing the throughput performance enormously.



## Western Digital single chip floppy controller

The WD279X series of floppy disk controllers combine the standard feature of Western Digital Corporation's WD179X series, with a digital data separator, phase lock loop and write precompensation circuitry, often the hardest design problem to overcome.

Powered from a single 5 V supply, the WD279X is capable of single and double density operation and is software compatible with the industry standard controller interface. Up to four 5½" and 8" floppy disk drives may be accommodated and the WD279X will also allow for double sided operation.

For more information contact Daneva Australia, 66 Bay Rd, Sandringham Vic. 3191. (03) 598-5622.

## Q.T. Computer Systems have moved

Q.T. Computer Systems, a manufacturer of microcomputer systems and products, has moved to new, larger premises at 41 Sydney Street, Marrickville NSW 2204. (02) 519-2680.

They now provide a ground floor showroom for over-the-counter retail sales and the factory area includes a service department for warranty and after sales service.

## CP/M capability for Apple III

The Apple III personal computer will now run CP/M-based application programs with the introduction of the Apple Softcard III System.

The Apple Softcard III System was developed by Microsoft Corporation and is now being distributed exclusively by Apple Computer.

The system augments the Apple III sophisticated operating system (SOS) to bring dual-processor capabilities to Apple users. The Apple III product marketing manager states, "The range and variety of programs compatible with these two operating systems makes the Apple III an enormously flexible computer for business, science, industry, and education."

A major feature of the system is that it supports the Apple 5M mass storage system, Profile. Both SOS

and CP/M files can be stored on Profile.

No hardware or software modifications of any kind are required to install the system circuit board, which plugs into any of the Apple III's peripheral card slots. Operation of the Apple III is not affected when not in the Z80 mode.

The Apple Softcard III System includes a plug-in Z80 microprocessor card, CP/M software, and four manuals which describe card installation and use of the software. The system also provides Microsoft Basic. The system requires a 128K Apple III personal computer with a suitable video display device.

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# Here's to longer life with Datalife from Verbatim



Verbatim is committed to offering customers the very best removable magnetic storage media. Our line of highest quality magnetic storage products extends to virtually all removable media forms and includes

Datalife TM flexible disks and minidisks, data cartridges, data cassettes and Datalife TM head cleaning diskettes. Verbatim is intent on keeping their products at the forefront of technology, going above industry standards, setting a new standard for excellence.



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## Apple at Australian Computer Exhibition

The powerful networking capabilities of the Apple II personal computer was demonstrated at the 9th Australian Computer Exhibition held in August at Hobart.

The networking was achieved by linking the Apple II through the use of Omnidet, a shared access network, which allows any station to transfer data without the need for a master network controller or a mass of wires.

Also on display was a new terminal emulator, known as 'Netcomm', which allows the Apple 'to talk' to IBM, ICL, Burroughs and other

major mainframes.

Using one of the internal expansion slots, 'Netcomm' communication card can be connected to an external modem or acoustic coupler via RS232-C convention, or directly to an onboard auto dial and answer modem which is designed in Australia, and is expected to be released by October this year.

In order to free the Apple pro-

cessor from the often complex task of monitoring the various communication conventions, it was decided to built 'Netcomm' around a Z80 processor. This enables the communications protocol to be maintained in the background so the Apple processor is free to transfer information from or to disk, to printers or other peripherals while on-line to a host mainframe or mini.

## Ortex announces MicroAda compiler

A local computer systems manufacturer, Ortex Australia Pty Ltd, has announced the availability of a MicroAda compiler for its range of Pascal System 1 minicomputers.

Ada is a new block structured high-level language that has been developed by the US Department of Defense to be used for all its internal software development.

MicroAda implements a subset of the full Ada language, including packages and separate compilation, tasks, and exceptions. Generics, representation specifications, and the more complex exception handling features are not yet included, though Ortex intends to support the full language within twelve months.

For more information contact Ortex Australia Pty Ltd, P.O. Box 732, Fyshwick ACT 2609. (062)80-5283.

### STOP WASTING TIME TESTING BOARDS

MD will pin-point microtroubles in seconds. Portable and simple to use by non-technical staff in the REPAIR SHOP or on the PRODUCTION LINE. MD tests ROM, RAM & I/O and prints diagnostic reports. MICRODOCTOR can be plugged into an unknown system to perform a general diagnostic and print a MEMORY-MAP.

The ENGINEER may enter sequences of CHECKSUMS and RAMTESTS. READS and WRITES to specific MEMORY and I/O locations. SHORTING tests on DATA and ADDRESS LINES. PRINT-OUTS of memory in ASCII or HEX. These sequences are retained in CONTINUOUS MEMORY, available always at the push of a key.

\* FREE Z80 DISASSEMBLER with each MD (other disassemblers soon to retrofit at low cost). Get a DISASSEMBLER LISTING of ROM in any microsystem!



MICRODOCTOR — \$595.00

### Z80 DEVELOPMENT SYSTEM

MENTA puts out a TV PICTURE of memory in hexadecimal. The 40 key keyboard will accept inputs, both in hexadecimal and Z80 mnemonics; there is a quick cassette data storage system, a powerful editor which permits program debugging by showing contents of registers and stack. Also there are 24 bits of I/O for external control. A Z80 disassembler is also available which outputs to any RS232 device such as a printer or terminal. MENTA was designed as a low-budget device for teaching microprocessing in schools; professional course-material is available to teachers together with add-on boards for a variety of control functions and robotic applications.



MENTA — \$249.00

### INTELLIGENT EPROM PROGRAMMER

Good tools need not be expensive. SOFTY 2 is the latest version of the engineer's favourite EPROM HANDLER for anybody who uses 2516, 2716, 2532 and 2732 EPROMS. SOFTY will program any of these EPROMS or copy any type into another.

SOFTY puts out a TV picture of memory contents, with many code-manipulating and editing facilities. There is also a fast cassette data storage system. SOFTY is also a ROMULATOR (a lead is supplied which may be inserted into a board under development to emulate the ROM using SOFTY's internal RAM. This procedure can also be used on the single-chip piggy-back type MPU.) SOFTY is complete in itself as a PRODUCT DEVELOPMENT SYSTEM. Code may be entered in HEXADECIMAL via the keyboard also SERIAL and PARALLEL inputs and outputs allow downloading of object code from your computer or printing EPROM contents on your printer.



SOFTY 2 — \$379.00

**Castle**

ELECTRONICS

P.O. Box 311, Castle Hill NSW 2154. Ph. (02)634 7597.

## Three new Texas Instruments microcomputer modules

Three microcomputer modules, an analogue-input, counter/timer and interface module were recently announced by Texas Instruments as the latest additions to TI's TM990 family of single-board microcomputers.

The TM990/315 is a low-level analogue-input module that enables TM990 boards to handle inputs from such devices as thermocouples and strain gauges. The module, which fits directly into the TM990 system bus, is available in versions with either 8 or 16 electrically isolated, differential inputs. For applications requiring more than 16 inputs, the system can be expanded with additional modules to include up to 128 channels. An on-board programmable amplifier provides auto-zeroing and six gain-settings for an input sensitivity of 10, 20, 50, 200, or 500 millivolts (full scale).

Capable of withstanding common-mode voltages as high as 250 volts, the TMS990/315 has a sample time of six milliseconds per channel and a relative accuracy of  $\pm 5$  microvolts at  $24^\circ\text{C}$ .

The TM990/315 operates from a +5 and +12 V power supply ( $\pm 3\%$ ) and draws approximately 1.3 A (typical).

Another new module, the TM990/317, is a counter/timer module that can serve as a pulse counter, programmable timer, and waveform generator. The TM990/317 offers four TTL software-gateable counter inputs with programmable debounce filters and five independent 16-bit counters with a 5 MHz counting rate.

The counters have both up/down and BCD/binary counting capability. Each counter has five outputs, and two of the counters have alarm comparators.

The TM990/317 requires a 5 V ( $\pm 3\%$ ) power supply and has a 0.9 A current requirement (typical).

The third new board is the TM990/309, an interface module

designed for use with TI's 6MT Series of input/output industrial modules. By providing an interface between the TM990 bus and 6MT modules, the TM990/309 enables microcomputers such as the TM990/101 to input status from and control the high voltage/current loads found in industrial-control applications.

For applications involving more than 32 I/O points the TM990/309 requires a 5TI-5500 I/O expander which allows the TM990/309 to supply power to as many as twelve full 6MT bases.

All inquiries to Texas Instruments, 9 Byfield Rd, Nth Ryde NSW 2113. (02) 887-1122.

## Elmeasco Instruments to distribute disks for Intel systems

Elmeasco Instruments has announced a range of Winchester disks for use with Intel microcomputer development systems.

The disks are designed and manufactured by Data Management Labs of San Jose, California, which recently appointed Elmeasco its Australian distributor.

Improved performance, capacity and reliability are the major reasons behind using Winchester disk technology in conjunction with microcomputer development systems, says Elmeasco's computer products manager, Daryl Black.

Most importantly all Intel software runs without modification. The DML controller emulates standard Intel controllers. As far as ISIS-II is

concerned an Intel 710, 720 or 740 is attached to the system and as a result all existing software, including custom I/O drivers, will operate.

There are two basic DML Winchester disks. The model 1010 offers 6 Mbytes of storage and is priced at \$8000, while the model 1040 has 26 Mbytes and is priced at approximately \$11 000. Each can be used with an optional floppy disk for program load and backup.

For further information contact Daryl Black, Elmeasco Instruments, 15 McDonald St, Mortlake NSW 2137. (02) 736-2888.

### Micro Professor MPF-1



\* A learning tool for hobbyist, students and microprocessor enthusiast. An excellent teaching aid for instructors of electrical engineering and computer science courses.  
\* A complete hardware and software system, offering detailed schematics and examples of program code to enable you to easily understand what the world of microprocessors is all about.  
\* More than a learning tool, you can design your own custom hardware and software applications.

\$115 + S.T.

## Hand Held, Digital and Analogue Multimeters

### ESCORT EDM 302



\$94.00  
+ Sales Tax

Escort Multimeters available  
now from as little as \$59.50 + S.T.

### AKIGAWA L300B



\$39.00  
+ Sales Tax  
**Probe**  
\$29.00  
+ Sales Tax

- \* Protected against the interference of external magnetic field by core magnet type meter.
- \* A 100 degree wide view meter and mirrored scale enables easier and more accurate reading.
- \* Protected from shock and vibration by shock resistant ABS housing.
- \* Meter movement and components are protected against overload by Zener diodes and glass fuse installed.
- \* "off" range position also protects the meter movement from shock and vibration.
- \* Designed with no metal portion to appear on the surface of the instrument. This guards the users from unexpected electric shock during measurement.
- \* The continuity range is a separate switch position that indicates continuity of a circuit by sounding a buzzer.
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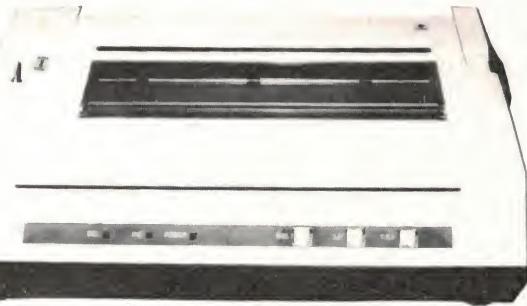
NSW: Radio Despatch Service 211 0191. Emtronics 211 0531. David Reid Electronics 29 6601. Pre Pack Electronics 569 9797. Martin de Launay (Wollongong) 28 6020. (Newcastle) 2 4741. VIC: Radio Parts 329 7888. SA: Int. Communications Systems P/L 47 3688. WA: Hinc Engineering P/L 381 4477. ACT: Electronic Components P/L 80 4654. TAS: D & I Agencies 23 2842.



# C. Itoh PRINTERS

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## Pro/Writer Printer 8510

**Print Features:** Number of columns—136 col. max. Print Speed—120 CPS. Print Direction—Single-directional and Bidirectional. Switch Selectable. Throughput Speed—From 44 to 152 lpm. Character spacing (max. number of columns per line)—Pica 10 CPI (80), Double Width 5 CPI (40), Compressed Font 17 CPI (136), Double Width 8.5 CPI (68), Elite 12 CPI (96), Double Width 6 CPI (48), Proportional Double Width Proportional. Line Spacing—Variable to 1/144". Print Width—203 mm (8") max.

**Forms Type:** Fan Fold Roll or Cut Sheet. Width—113 mm to 254 mm (4.5" to 10.0"). Total Thickness—0.05 to 0.28 mm (0.002" to 0.011"). Number of Copies—Original + 3 copies nominal.

**Form Feed:** Method—Tractor or Friction. Form Loading—Either rear or top.

**Interface—Serial:** Method—EIA RS232-C and 20mA (40 & 60mA switchable option) Current Loop Serial Interface. Baud Rate (BPS)—110, 300, 600, 1200, 2400, 4800, 9600. Transmitting Method—Half Duplex. Synchronization—Asynchronous.

**Interface—Parallel:** Method—TTL compatible, 7-bit, parallel interface. Control Signals—ACK, BUSY, SELECT, DATA STB, INPUT PRIME FAULT, INPUT BUSY, PAPER EMPTY. Instruction Codes—(ASCII): CR, LF, VT, FF, CAN, SO, SI, DEL, DC1, DC2, DC3, DC4, GS, RS, US, FS, EM; GRAPHIC SYMBOLS: BIT GRAPHICS.

**Error Detection:** (1) Parity (VRC)—Odd, Even, No-parity. Switch selectable. (2) Framing Error—Stop bit check. (3) Overrun Error—Error is detected when data are received before the previous data have been processed.

**Physical dimensions:** 398 mm W x 120 mm H x 285 mm D (15.7" W x 4.7" H x 11.2" D). **Weight:** 8.5 kg (18 lbs., 12 oz.)

**P\* \$759 (\$725 ex)**

**S\*\* \$845 (\$775 ex)**

## Model 1550

The Model 1550 is a compact desk-top dot matrix serial impact printer used for data communication terminals, hardcopy of CRT displays, peripheral terminals for minicomputers and microcomputers, and small-sized business systems. The character format is a dot matrix of 7(H) x 9(V), or 8(H) x 8(V). Print speed is 120 characters/second. Up to 136 characters can be printed per line at 10 CPI.

Its main features are: • Compact desk-top dot matrix printer • 136-column print • Lightweight • Low power-consumption • High-quality print • Bit image graphics • Graphic Symbols • Prints in six different languages • High reliability • Low cost.

**P\* \$1225 (\$1050 ex)**

**S\*\* \$1275 (\$1195 ex)**

## F-10 Printmaster Daisy Wheel Printer

**Print Speed:** 40 CPS. **Print Method:** Static Print Impact. **Number of Printable Columns:** 136, 163, Variable. **Character Spacing:** 1/120 Inch (minimum). **Line Spacing:** 1/48.

**Return Time:** 900 msec. **Line Feed Time:** 40 msec. **Paper Width:** 406 mm (maximum).

**Print Characters:** 96. **Printwheel:** Industry Standard 96 Character Wheel. **Interface:** Industry Standard 8-bit Parallel, RS232-C Compatible, X-ON, X-OFF, 12-bit Qume and Diablo Compatible. **Dimensions:** 574 mm W x 405 mm D x 153.5 mm H (22.5" W x 15.9" D x 6" H). **Weight:** 14 kg (30.8 lbs.) with cover and power supply. **Noise:** Less than 65 Db (IM from Platen, A Scale).

**P\* \$1600 (\$1450 ex) \* Parallel Interface \*\* Serial Interface**

**S\*\* \$1750 (\$1510 ex)**

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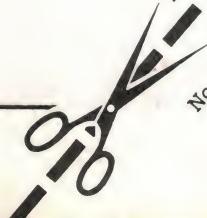
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## VDU monitors

A range of high and medium resolution monitors aimed at OEM users is now available from Thomas Electronics.

The basic 12" monochrome monitor is priced at under \$A100 FOB Japan. This unit features a 15 MHz bandwidth, 1000 lines resolution, adjustable screen tilt metal frame, and is available with either a white or green phosphor tube incorporating an etched anti-glare screen.

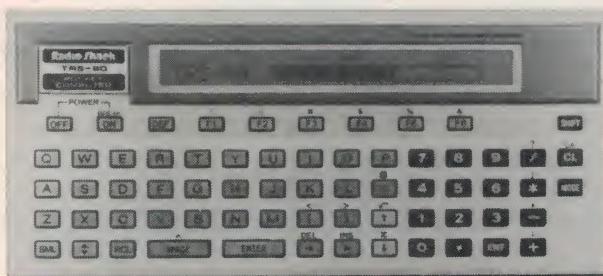
The full monochrome range consists of frame or cabinet versions with 5", 9", 12" and 15" tube sizes, with P4 (white phosphor) or P31 (green phosphor) as standard. Band widths are up to 50 MHz with resolutions in 800 — 1800 lines.

The colour monitors are in sizes

of 12", 14" and 20", RGB phosphor tubes with either delta or in-line gun types. Included are both open frame and cabinet types of monitors with band widths up to 35 MHz and display formats from 2000 characters to 4000 characters.

The monitor range is complemented by video RAMs to provide a CRT controller for colour data systems and two types of switching power supplies for operation on 90 — 264 Vac 50/60 Hz.

For more information contact Thomas Electronics of Australia Pty Ltd, 12 Larkin St, Riverwood NSW 2210.



## Tandy's new pocket computer

Tandy Electronics has introduced a new handheld portable computer, Model PC-2, which is now available for \$319.95.

Among the features of the 27 x 195 x 86 mm computer are its capability for internal expansion with plug-in RAM and/or ROM modules, and for external expansion through a 60-pin I/O buss connector.

The PC-2 features a 16K (ROM)

extended BASIC language interpreter with ability to process words and messages. The CPU is a high-speed 18-bit custom CMOS microprocessor. The built in memory includes 16K of ROM and 2640 bytes of user memory.

## Club Call

**MEGS, the Sydney Microcomputer Enthusiast's Group**, now meet at St Andrews Presbyterian Church Hall, 37 Anderson St, Chatswood (changed from WIA hall, Atchison St, Crows Nest). Meeting date is still the third Monday of the month, time: from 7 to 10 pm. The church hall is just behind Wallaceway and is conveniently near the railway station and buses.

It's quite likely that many of you have the incorrect address of the venue for the **North and Western Suburbs Computer Users Group** meetings. So please note that the correct address is Maribyrnong Primary School, Warrs Road (off Raleigh Road), Maribyrnong. Meetings are held every second Thursday from 7.30 pm to 10 pm and you can contact Mr. David Coupe on 370-9590.

A new club which formed in July is the **Pocket Computer Users Club**. If you have an interest in pocket computers, whatever the brand, you will develop a better understanding of them through the club. The meetings are held on the first Wednesday of each month at 7.30 pm at the 'Woodstock' Community Centre, Church St, Burwood. Interested people can contact the President, George Antonijevic, at home on 683-4296.

The SA branch of the **Commodore/Vic Computer Users Association** is a functioning user group, established so that enthusiasts can meet and discuss all aspects of computing. The club meets monthly and if you want to find out when and where write to Mr. Eddie Hann, the secretary, at 13 Miranda Rd, Paralowie SA 5108.

**Apple-Q, the Brisbane User Group**, has been in operation for almost a year. User Group days are held every third Sunday of the month (December excluded) at the Hooper Education Centre, Kuran Street, Wavell Heights. The Centre is open from 8.30 am until 4.30 pm and members are encouraged to bring their Apple along. Barbecue facilities are available for members staying all day. Those interested in becoming members of Apple-Q should forward \$18 subscription fee to the Secretary, Apple-Q, the Brisbane User Group, P.O. Box 721, South Brisbane Qld 4101. Apple-Q is affiliated with the International Apple Core.

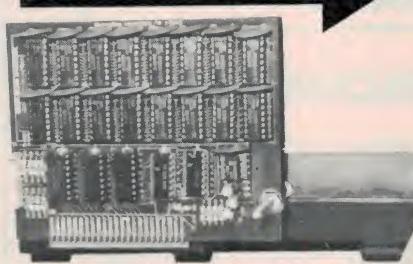
**The Blue Mountains Computer Club** is still going strong and meets on the second and last Friday of each month at the Springwood Civic Centre. Meetings start at 7.30 pm.

## 32K BYTES FOR THE ZX81 SPECIAL RAM PACK FOR THE ZX81

This board uses dynamic RAM chips for lower cost and lower power consumption. Simply plugs into the ZX 81 expansion port offering 32K BYTES for basic programmes and data handling. No extra PSU required. Extra memory to help you build your ZX81 into a powerful microprocessor system at an affordable price. Compare the price with other RAM PACKS available on the market!

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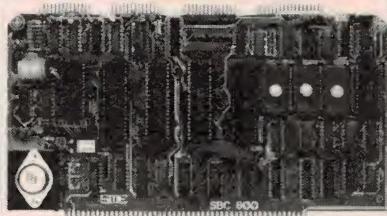
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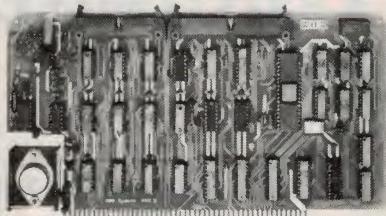
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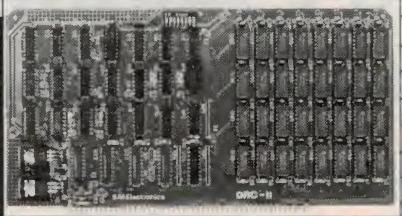
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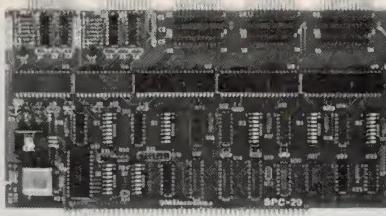
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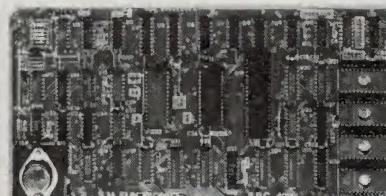
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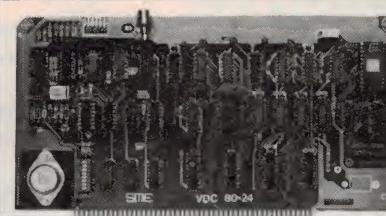
**SPC-29**



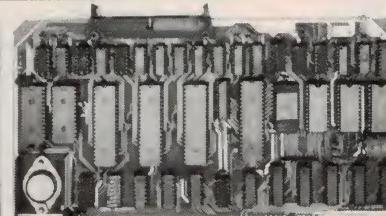
**SBC-400**



**CRC-48**



**VDC-8024**



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# 16 Channel computer output driver

With this project hooked up to your computer you can drive relays, motors, lamps, solenoids, or whatever, under software control. Do something useful with your computer!

**Geoff Nicholls**

A PERSONAL COMPUTER need not necessarily be used for playing games, learning programming or producing computer club newsletters. With this project, you can put it to some practical use. Just what that is I'll have to leave to your imagination and ingenuity!

Two independent groups of eight outputs are provided. Each of the 16 output driver circuits is configured to run from a 12 V supply, although higher supply voltages may be used. Each can be configured to sink up to 3 A. Simple address selection for the board is provided by an on-board DIP switch. It's a pretty straightforward project and you can vary things to suit your application(s).

## Component options

The component values shown in the circuit diagram are for output currents of up to 2 A. If other load currents are desired, then a few components need changing in order to reduce power dissipation in the output transistors.

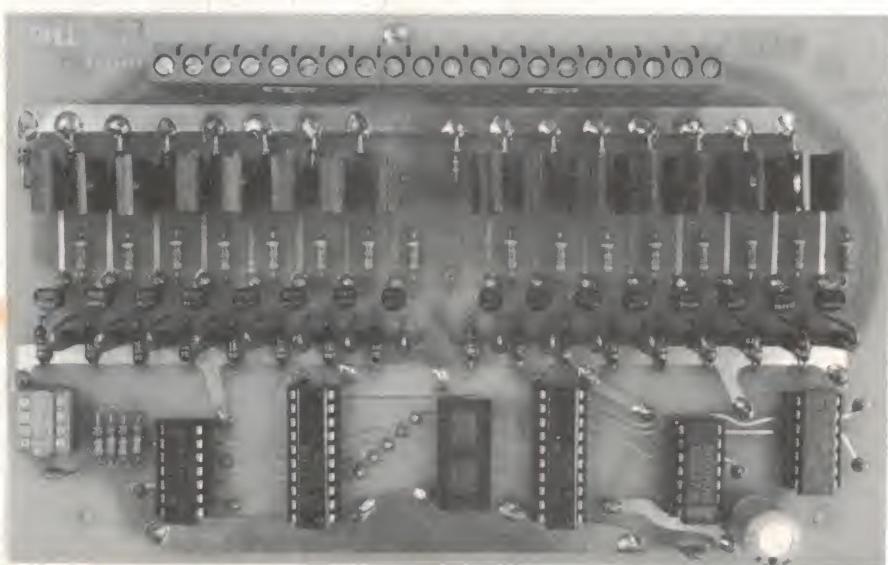
For currents of less than 1 A, the TIP31Bs (Q17-32) may be replaced by BD139s — which have the distinct advantage of costing considerably less than TIP31Bs. However, note that BD139s have a different pinout such that the metal face on BD139s is on the opposite side of the package to the TIP31Bs.

The base current drive to the output devices is determined by R17 and R32 and may be optimised for different loads. The table here (Table 1) summarises component values for various output currents.

If the total output current is expected to exceed 20 A for more than a few

TABLE 1. Component variations

OUTPUT CURRENT amps	Q17 to Q32	R17 to R32	R1 to R16	+5 V SUPPLY CURRENT (max.)
3	TIP31B	15R/1W	330R	3.4 A
2	TIP31B	18R/1 W	470R	2.8 A
1	TIP31B	22R/½ W	470R	2.3 A
<1	BD139	33R/½ W	470R	1.6 A



The project is built on a board measuring 103 x 165 mm. minutes, then it is advisable to make the following changes:

(a) Use a terminal strip capable of passing half of the total load current through each terminal OR solder the power ground directly to the pc board ground plane.

(b) Solder several lengths of tinned copper wire to the heavy power ground track on the pc board.

Intermittent use over 20 A should not require these changes. The power dissipation calculations for transistors Q17 to Q32 were based on data for RCA-manufactured TIP31Bs. The prototype transistors developed a collector-emitter voltage of 0.65 V at 2 A, which does not necessitate heatsinking the transistors. If high current loads are to be used, measure Vce and Ic

and calculate  $P = Vce \times Ic$ .

The TIP31B can dissipate 2 W at 25°C ambient without heatsinking. Continuous use at high currents may require a small flag heatsink on each TIP31B.

## Construction

The entire electronics for this project is mounted on a double-sided pc board. During the early design phase, it was found that a single-sided pc board would require an unacceptably huge number of links. To keep the cost down, through-hole plating was not specified for this board and connections between top and bottom side tracks are made with links of 22 swg tinned copper wire, of which there are a total of 61. IC sockets were installed on the prototype, but these are not essential.

Commence construction by giving the pc board a good inspection, looking for broken tracks and undrilled holes. Make sure the tracks are clean and bright so that soldering is easily carried out. Insert all the links first. These are identified on the component overlay diagram by a •. Note that a large star is next to a '62nd' link more or less in the

# computer output driver

centre of the board. This is the optional 0 V link — see the text under the heading 'Power supplies'.

Next, solder diodes D1 to D17 in place. Note that the cathodes of these diodes are soldered on the *component* side of the board. Solder resistors R1 through T16, then R33 through R48 in place next. Mount and solder the BC639 transistors, Q1 to Q16, in place next. All the 1 W resistors, R17 through R32, stand up on end and these may be soldered in place after the transistors. Follow with the remaining four resistors and the three capacitors. Now you can mount and solder in the output devices, Q17 to Q32. Watch orientation.

Now mount DSW1, but take care you put it round the right way. The ON position of the switches should be adjacent to the edge of the board. If you're using IC sockets, put these on next. If not, solder the ICs in place. Note that ICs 1, 2 and 5 are CMOS types, so take precautions in handling and soldering them in place. Only handle them by the ends of their cases after discharging yourself against an earthed metal object. Solder the supply pins first. A 16-pin DIL IC socket is used for the input connections and this can be mounted now. Last of all, mount and solder in the output terminal strip or strips. We used one 12-way and one 8-way strip as we could not obtain a single 20-way strip.

Having completed the construction, go over the board very carefully, looking

for missed links and components, bad joints or mis-oriented semiconductors. Fix any faults and, if you're satisfied all is well, the best way to test the board is to hook it up and try it out!

## Power supplies

The logic power supply of +5 V should be supplied from the host computer Vcc rail through the DIL socket pins 15 and 16. The computer's ground (0 V) should be connected to pin 9.

The +5 V power to the driver circuits should not come from the host computer unless it has the capability to supply at least an extra 3 A. In any case, heavy wire should be used (at least 24 x 0.2 mm hookup wire) for the power connections to the terminal strip to minimise voltage drop.

The optional 0 V link (marked with a star) should only be used for light loads. Normally, the connection between 0 V logic and power should be at the power supply.

The output drivers' power supply is shown as +12 V, but other voltages may be used, up to about 70 V. The PIV rating of diodes D1 to D16 should not be exceeded, however (best use 400 V diodes here, at least).

## Hooking it up

The ETI-653 has been designed to allow up to eight boards to be connected to a computer through a single ribbon cable. In order to do this a special strobe signal must be supplied by the computer

whenever any of the ETI-653 boards are being selected. This will probably require a small hardware circuit, unless your computer is favoured by the famous Murphy! If there is sufficient interest we may publish a general purpose interface board, but until then you will have to work out for yourself how to connect a particular computer from the following guidelines. (For background information, refer to ETI August '82, *Turtle Interfacing Fundamentals*.)

I will assume that the computer has an I/O scheme with eight I/O address lines — AD0 to AD7. The ETI-653 inputs A0 to A3 are then connected to the lowest four I/O address lines of the computer, i.e. AD0 to AD3. Each ETI-653 board is then set up at a different address via the DIL switches, DSW1, 2 and 3. This means that the ETI-653s will occupy 16 consecutive I/O ports. Now for the hard part!

The STROBE input (A4) must have a positive or negative going edge (see the How it Works) that occurs when an I/O WRITE to the ETI-653s is taking place. In order to fully decode the I/O port address space, the other I/O address lines (AD4 to AD7) must be gated with the I/O control signals to produce the STROBE signal. In order to get the STROBE transition timing correct, a signal such as WRP (write pulse) should also be gated in the STROBE logic. This allows the data bus to settle before the latches are locked.

The ribbon cable requires a buffered driver for each wire carrying logic signals, especially if multiple ETI-653s or long cable runs are envisaged. ▶

## PARTS LIST — ETI-653

**Resistors** ..... all 1/2 W, 5% unless noted  
 R1-16,33-48 ..... 470R  
 R17-32 ..... 18R, 1 W  
 R49-52 ..... 10k

**Capacitors**  
 C1 ..... 100u/16 V RB electro.  
 C2,C3 ..... 100n blue chip ceramic

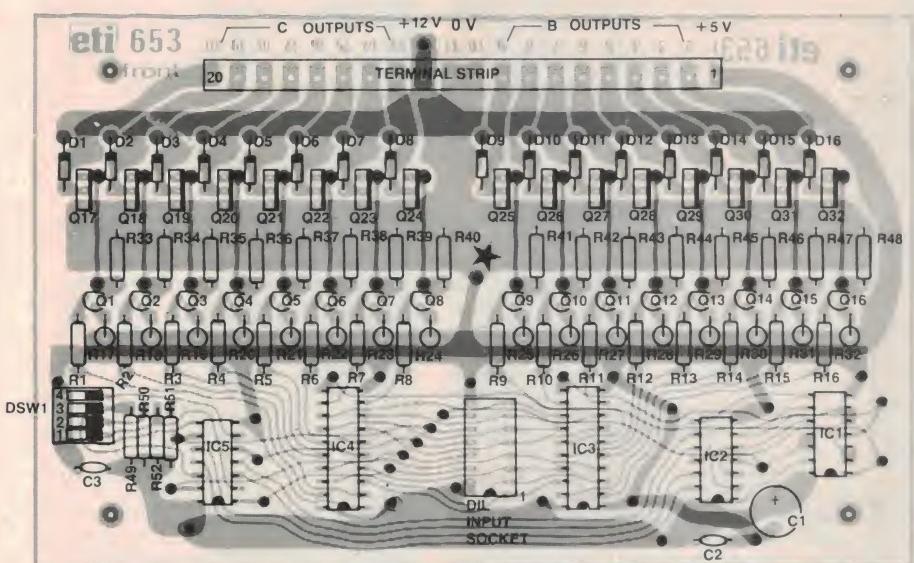
**Semiconductors**  
 D1-D16 ..... 1N4002, 1N4004 etc  
 IC1 ..... 74C02  
 IC2 ..... 74C00  
 IC3,4 ..... 74LS374  
 IC5 ..... 74C86  
 Q1-16 ..... BC639  
 Q17-32 ..... TIP31B, BD139 (see text)

### Miscellaneous

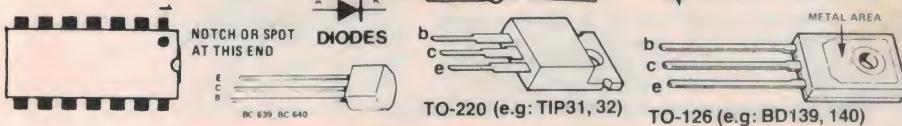
ETI-653 pc board; DSW1 — 4-way DIP switch; 16-pin DIL socket; IC sockets (optional) — 3 x 14-pin, 2 x 20-pin; 2 x 16-pin DIP headers; 1 x 12-way and 1 x 8-way pc mount terminal strips or 1 x 20-way type; suitable length 16-way ribbon cable; 22 swg tinned copper wire, etc.

### Price estimate

\$40 — \$45



### COMPONENT PINOUTS



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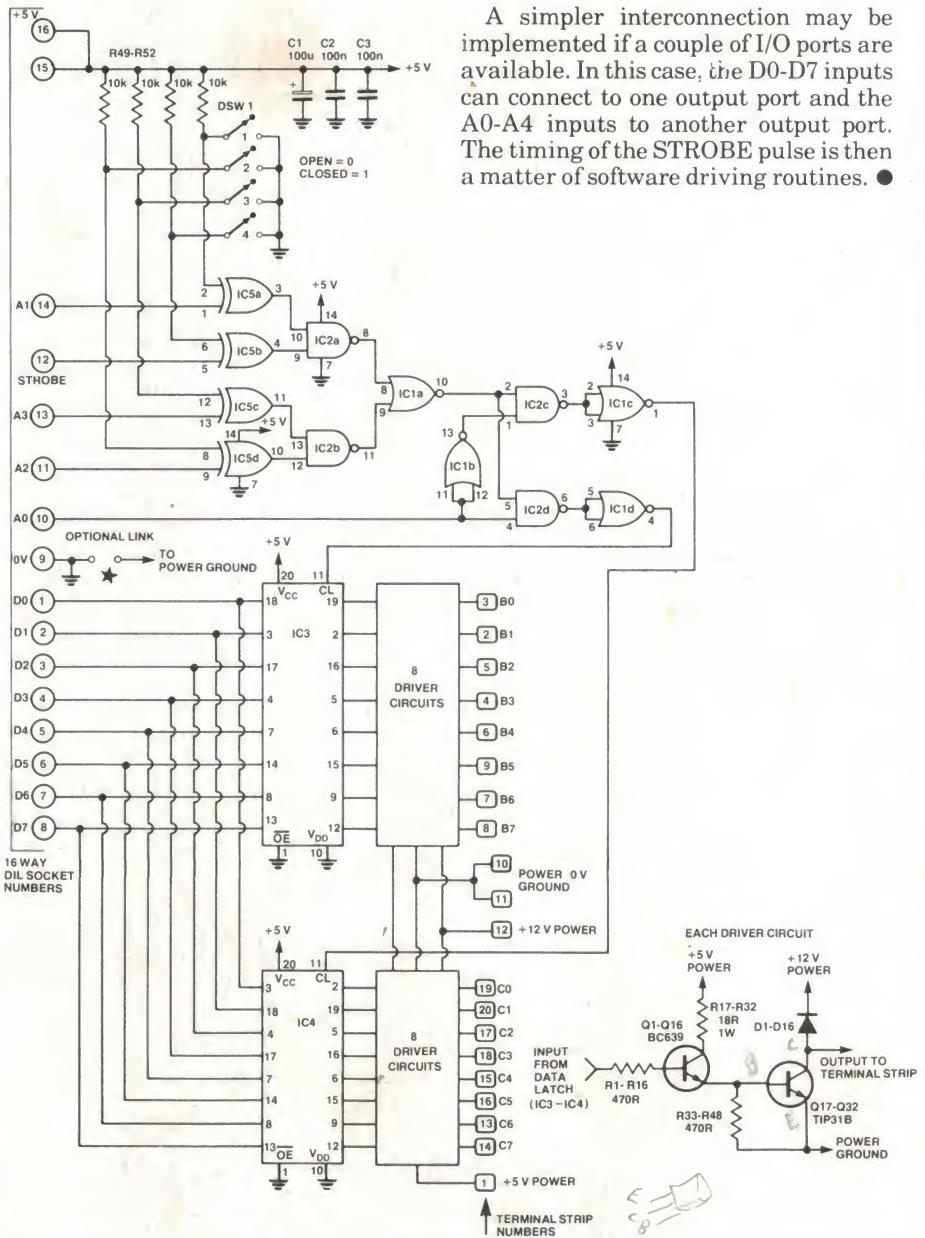
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## Project 653



### HOW IT WORKS — ETI-653

First of all, note that the component values shown on the circuit diagram are for the 2 A output version. Other output current versions are possible, as explained in the text, but basic circuit operation is the same.

The host processor connects to the ETI-653 board via the 16-pin DIL socket. IC5 compares the logic levels present on the DIL socket pins 14 (A1), 11 (A2), 13 (A3) and 12 (STROBE) to the settings of DSW1, 2, 3 and 4 respectively. When a match is found, pin 10 of IC1 goes high. The STROBE input should receive a pulse edge timed to coincide with a valid data bus (pins 1 to 8 of the DIL socket) and a valid address (pins 11, 13, 14). Note that either a positive-going or a negative-going edge of the strobe pulse may be used, according to whether the setting of DSW4 is closed or open, respectively.

The A0 input on pin 10 of the DIL socket determines which of the two on-board latches are being addressed. When pin 10 is low, IC4 is selected ('B outputs active'), if high, then IC3

A simpler interconnection may be implemented if a couple of I/O ports are available. In this case, the D0-D7 inputs can connect to one output port and the A0-A4 inputs to another output port. The timing of the STROBE pulse is then a matter of software driving routines. ●

('C outputs active').

Each driver circuit buffers one of the 16 latch outputs and provides an open collector sink of up to 3 A (see the text on 'Component options').

To simplify the description of the driver circuits, consider the one comprising R1, Q1, R17, R33, Q17 and D1. Diode D1 is a flywheel diode and protects transistor Q17 from excess back emf voltage when turning off inductive loads, such as a solenoid. When the latch output is low, Q1 is held off via R1 and Q17 is held off by R33. Resistor R33 speeds up the turn-off time of Q17 by providing a path to remove stored charge in the base-emitter junction.

When the latch output is high, about 5 mA of current flows into the base of Q1, thus turning it on. R17 sets the base current of Q17 and is chosen according to the output current requirement. Transistor Q17 must be saturated in order to reduce power dissipation and up to 300 mA of base current may be required for 3 A loads (see component options in main text).

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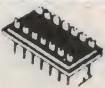
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### SPECTROL 43P ACTUAL SIZE

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ACTUAL SIZE

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\$21.75 A number of programs written to aid you in using your TRS-80 and Level II BASIC for the design and analysis of many electronic circuits. The programs analyse information on ms values, periodic waveforms, integrated circuit timers and bipolar transistor circuits.

**MOSTLY BASIC: APPLICATIONS FOR YOUR TRS-80 — BOOK 1****21788P**

\$19.25 28 ready-to-use BASIC programs which have been completely tested and debugged. Programs include a telephone dialler, digital stop-watch, spelling test, house buying guide, gas mileage calculator, and others. Complete with explanations of each program, sample runs, and complete program listing.

**MOSTLY BASIC: APPLICATIONS FOR YOUR TRS-80 — BOOK 2****21865P**

\$19.25 32 ready-to-run BASIC programs, including two to test your ability in history and maths, a Dungeon of Danger that's strictly for fun, eleven household programs, seven on money and investment, two to test your ESP level, and more. Complete with explanations, sample run and listing for each program.

**INTERMEDIATE PROGRAMMING FOR THE TRS-80 MODEL I****21809P**

\$14.95 Step-by-step instructions for the TRS-80 user who wants to progress from BASIC to machine and assembly language programming with the TRS-80 Model I system. A complete how-to guide with numerous examples.

*continued on page 98*

## BLACK JACK

W.F. Kreykes, St Albans Vic.

Bill Kreykes has come up with an absolutely amazing program here that really shows what CHIP 8 is capable of if you're prepared to work at it. Even if you're not a card player, this one's a ripper.

Traditional Black Jack is played with four decks, though casinos generally now play with six decks (but you can't fit that on the '660, yet). This program plays traditional Black Jack with four decks. The '660 is always the banker with an opening balance of \$1500. Players A and B (George and Bill in this program) start with \$750.

Whenever a decreasing line appears above a player's name the banker is looking for a reply. When asked to place bets, enter the amount you desire — maximum \$45, minimum \$2. When asking for a yes/no reply. Once the line has disappeared your turn is no answer, only press any key from 0 to 9 for a YES reply, no response is required for a NO reply.

The banker is very impatient and will not wait all day terminated, except when placing bets which are above or below minimum or maximum.

A simple check can be maintained on the program with regards to any sceptical participant who may doubt the payment of winnings. Every time the bank balance is displayed the three amounts shown should add up to \$3000.

The game is automatically re-started if the bank's balance falls below \$200 or a player tries to bet money he has not got (no room for an IOU).

The bank shuffles the four decks of cards at the start of each game and then signals another shuffle to take place at the 186th card. However, the cards will not be shuffled until the next round is about to start. The bank can be forced to shuffle the deck before this time by each player not placing a bet at the start of the round.

### House Rules

- The bank cannot sit on less than 17; players — no minimum.

• Insurance is offered if the bank's first card is an ace. The maximum amount of insurance is half of your bet. If the bank does get Black Jack, he/she will play quadruple.

- Players' cards equal to bank — bets returned.
- Players' cards less than bank — bets lose.
- Players' cards greater than bank — bank pays.
- Bank plays Black Jack three times.
- Bank plays 5 under 22 double.
- Splits on any pair, but can only be done on first hand.
- Doubles on 9, 10 or 11 then only one more card dealt.
- Bank's first card an ace: if Black Jack, insurance pays four times; if not Black Jack, insurance loses.

A complete explanation of how the program is constructed and how it works will have to be left for another issue, unfortunately.

0600	290a	6d17	aee0	2860	6c22	aeeff	29f6	ae4d	0930	6d2b	f565	4000	194c	f029	2946	f129	2946
0610	6d1d	6c18	29f8	ad9b	6c18	6d24	29f8	6c00	0940	f229	2946	f329	dcd5	7c05	00ee	3100	193c
0620	6d23	ae74	dcd7	7c0c	dcd7	7c1d	dcd7	7c0c	0950	3200	1940	3300	1944	00ee	2962	298c	af34
0630	dcd7	7cce	ae31	3c06	1624	ae44	6c00	6d2b	0960	f355	af34	6c2d	1930	af28	2978	af28	f355
0640	dcd5	6c24	dcd5	6001	6105	6200	6300	296c	0970	00ee	af28	298a	196c	f565	29a2	8410	8354
0650	6000	6107	6205	2928	295e	2864	3000	1668	0980	28ba	af19	f065	8404	19c2	f565	29a2	8410
0660	62fe	8214	3f01	1d6a	2a0c	2864	166e	6901	0990	8355	3f00	1854	4400	1d56	74ff	7364	28ba
0670	80b0	af10	28ce	af22	28f4	276e	275a	6d1d	09A0	19c2	4000	19ac	710a	70ff	19a2	4200	19b6
0680	3600	168e	6c02	277e	2880	2920	2b42	2760	09B0	730a	72ff	19ac	4400	00ee	750a	74ff	19b6
0690	277e	2880	2920	275a	6700	6a00	6801	6921	09C0	00ff	af17	f433	af18	f365	00ee	28c0	28d2
06A0	2b58	682a	6703	2b58	af10	f065	90b0	1c6e	09D0	4000	19de	f029	dcd5	7c04	29e4	19e8	4100
06B0	2b42	6818	2778	285c	2b5e	400b	27e4	2b42	09E0	00ee	7c02	f129	dcd5	7cfe	00ee	ae8e	6c0b
06C0	6705	2b66	285c	6901	2b6e	276e	2d26	6801	09F0	6d0d	29fa	29fa	29fa	c51f	f500	f601	
06D0	28f2	6c02	2870	6c0e	680d	2870	682a	2d26	0A00	ff18	6505	dcd5	7c08	f51e	00ee	6302	6107
06E0	6601	2b42	2d26	2764	2870	6c37	6836	2870	0A10	6210	f215	f207	f200	f318	3200	1a14	71ff
06F0	2d26	6705	2b42	285c	2b66	2774	2a96	af1c	0A20	3100	1a10	00ee	4bba	290a	af3a	fb1e	f065
0700	f065	400b	1c42	170c	2b42	2aea	6110	81e5	0A30	7b01	6110	8015	3f00	1a34	7010	af1c	fa1e
0710	3f00	1708	276a	2cca	2cca	2760	2cca	2cca	0A40	f055	2a48	7a01	00ee	f818	4921	1a52	ae2f
0720	2b42	285c	2774	28dc	40bb	1d32	40aa	1c6a	0A50	d89b	7903	6109	8105	3f01	1a68	7803	f029
0730	29ce	2738	00FF	165a	6a00	6818	af1c	fa1e	0A60	d895	7805	8e04	1a88	7802	400a	ae89	400e
0740	f065	4000	18f2	2a42	173c	ada5	6c12	6d0d	0A70	ae7f	400c	ae6b	400d	ae7a	300b	1a82	ae6f
0750	29f6	aed8	6d0c	dcd8	00ee	ae4d	29ee	1a04	0A80	7e01	c895	7e0a	7806	79fd	00ee	28dc	6921
0760	6d1d	6601	6c2b	6703	00ee	6c02	6d1d	6700	0A90	6d24	2a48	6900	6818	6a00	6e00	2a3c	00ff
0770	6600	00ee	6d06	6c06	6901	6705	00ee	ab44	0AA0	2a26	4e16	7ef6	4e15	1b8e	4901	1b2c	2b2c
0780	6410	3600	6435	6515	d451	74f8	d451	74f8	0AB0	af1c	f165	4563	1ac4	4701	1ac4	4704	1ac4
0790	d451	6302	60ff	7001	e0a1	17ba	4009	17a4	0AC0	9010	1b9e	4e09	1bde	4e0a	1bde	4e0b	1bde
07A0	1796	73ff	ae67	f318	d451	7401	4418	00ee	0ADO	84c0	2bda	8c40	6d24	1adc	2aea	4064	1738
07B0	443d	00ee	3300	1794	17a8	f518	73ff	4900	0AE0	277e	3302	1ada	2738	1bda	2850	2a26	6400
07C0	17a2	3300	17d6	8e00	29cc	4100	17d4	7e0a	0AF0	6e00	6500	af1c	4405	1b80	f065	400b	7501
07D0	71ff	17ca	80e0	28ca	29ce	6f50	7fff	3f00	0B00	4000	1b2c	610b	8105	3f01	1b10	8e04	1b12
07E0	17dc	17a4	6600	6702	2834	6c1A	3600	6c39	0B10	7e0a	6115	81e5	3f01	1b1e	7401	1af6	3500
07F0	6d17	277e	77fe	28c0	6100	4000	180e	70ff	0B20	1b26	2b2c	1c06	7ef6	75ff	1b12	2850	80e0
0800	9010	180e	7101	9010	180e	00ff	17fe	8300	0B30	1b62	ae16	19ee	2838	2904	1ado	274a	2904
0810	8e30	7702	28c0	8305	3f00	1828	29cc	2842	0B40	1ac4	6f25	ff15	ff07	3f00	1b46	00ee	6921
0820	2a0c	28c8	2844	17e8	28e2	2920	7703	6601	0B50	af1c	f065	2a48	1b62	28c0	4000	00ee	2a26
0830	3708	17ee	aec0	183a	ade4	6c0d	6d0d	29f8	0B60	2b42	af0e	18cc	6800	6909	1b70	6900	6818
0840	1750	2834	adcb	6c0b	6d0d	29f8	add5	29f6	0B70	28dc	1a48	2d3e	ad8c	1yf6	2d3e	ae6b	19f8
0850	80e0	19ce	28ba	19c2	2968	1d06	6d00	aea7	0B80	4901	1b88	2bd8	2904	60aa	ae84	1b92	60bb
0860	6c00	19f6	285c	7cfe	ae3a	29f6	af28	1932	0B90	ae49	dcd5	2b62	2a0c	1d44	ae84	1d3a	28fe
0870	28c0	4000	00ee	2b42	2a8c	7701	7c0c	00ee	0BA0	274a	277e	3300	1b3c	2904	2850	7cff	88c0
0880	28c0	4000	18e0	6e2d	81e0	8105	3f00	189c	0BBO	2b4e	7804	7c0d	6d1d	29cc	28c0	7701	28ca
0890	29ce	275a	2844	2a0c	2844	18b2	6e02	81e0	0BC0	28e2	2920	2b4e	274a	2904	2738	2b42	7cff
08A0	71ff	8105	3f01	18e0	29ce	275a	28b6	2a0c	0BD0	88c0	7c01	6563	1a8c	28fe	adfd	183a	28fe
08B0	28b6	28c8	167c	adc1	1846	af19	f333	00ee	0BE0	2838	277e	3300	1b36	2904	6d1d	29cc	28e4
08C0	af22	f71e	f065	00ee	6000	af22	f71e	f055	0BFO	28c0	8004	28ca	29ce	2920	2904	2aea	2b42
08D0	00ee	af16	f033	af17	f165	00ee	af0e	18c2	0C00	28fe	2838	1c20	4901	1c28	2bd8	2b32	2a0c
08E0	28c0	28d2	af2c	f155	af32	f155	af38	f155	0C10	28e0	2968	2904	2850	6d1d	29cc	28c8	2b32
08F0	00ee	af1c	6000	6100	f155	f155	18ee	aefe	0C20	2738	2904	6064	00ee	28fe	2c36	2a0c	2904
0900	ff55	00ee	aefe	ff65	00ee	601c	a66c	18ce	0C30	2850	6000	2b62	aea7	6c08	6d0f	29f6	ae20
0910	3600	191a	292c	297a	1928	2962	297a	195e	0C40	19f6	28fe	4e15	2b7a	3e15	2b74	2a0c	6600
0920	3600	195a	292c	298c	af2e	f355	af2e	6c09	0C50	6702	6c1A	2cae	6601	6705	6c39	2cae	4e15

## WORD 60

Another game for two players (George and Bill, still) from Bill Kreykes. The computer throws up groups of letters randomly and each player has to write down (on a notepad) as many words as possible within 60 seconds, at which time the letters disappear from the screen.

After the letters disappear, the players compare lists. Matched words are cancelled out. You score points for the words left. Any words spelled incorrectly or that contain a letter that was not displayed have points deducted. Plurals are acceptable, e.g. dog, dogs.

### Scoring

Three letters	.... 1 point
Four letters	.... 2 points
Five letters	.... 4 points
Six letters	.... 7 points
Seven letters	.... 10 points

The words ENTER SCORES will appear on the screen which is a prompt to record each player's score, be it plus or minus. The player on the left enters his/her score first.

To enter scores, press A for add, D for deduct, followed by the number of points. Do this for each player (remember, left player first).

At this stage a high-pitched tone will be heard. During the time the tone is on, if an error has been made in entering the score, you can correct it by pressing E and re-entering the correct score (wipe out the old ones first).

When the scores have been entered the game will automatically restart, showing the updated scores. A

player with a negative score will not have the score displayed until he or she again reaches or passes zero.

The first player to attain a score over 99 is declared the winner of the round.

### Names

The data from 0957 to 0979 contains the names George and Bill. This can be changed to suit individual needs. However, the data underlined must remain similar to what is shown or be replaced by zeros. This area is used to display the scores to be added or deducted.

OC60	2b7a	3e15	2b74	2904	170c	ae84	1d34	29ec
OC70	adb4	fc65	af0e	fc55	fc55	6b00	c71f	6ae6
OC80	8a74	3f00	1c7c	28dc	617e	8105	3f01	1c7c
OC90	fb00	ff18	af3a	fb1e	f055	7b01	7010	2b62
OCA0	3bc6	1c7c	6016	290c	29ec	6b00	166e	28e0
OCB0	6d17	29d0	3e15	1968	00ff	28e0	2910	28c0
OCC0	8004	8004	28e2	2910	1972	28e0	af13	f065
OCD0	8100	28c0	4000	187a	28dc	28fe	9010	1d04
OCE0	41bb	1858	8105	3f00	1d50	2d1a	2b42	40aa
OCF0	1cfa	30bb	1cfe	2972	2910	2972	2910	2972
OD00	2910	2d1a	2910	2904	6d24	40bb	1d38	40aa
OD10	1b9a	29ce	2904	29cc	187a	6d0e	285e	7cfe
OD20	29f8	7c02	1d2a	6c00	6d03	aee0	3600	aeef
OD30	19f6	ae49	dcd5	1732	ae49	dcd5	1d14	aec0
OD40	6c00	19f0	6e15	30bb	1c24	3901	1738	00ee
OD50	2968	2b42	1d06	6c09	3600	6c2d	ae20	29f8
OD60	2a0c	2a0c	2a0c	00e0	1600	6d0a	285e	adc1
OD70	29f8	7c02	ae44	dcd5	7c08	6102	6200	6300
OD80	293c	1d60	00ff	00ff	00ff	8e8a	8a8a	
OD90	eeee	a8ae	a2ee	ee88	ce82	eeae	aaaa	
ODA0	96d5	b595	96ee	8aee	28e8	8b89	8989	e9b8
ODB0	2038	0838	020c	0709	0e03	060b	040d	0805
ODC0	0a89	d9a9	8989	2434	2c24	248b	daab	8a8a
ODD0	a294	8894	a23d	151d	15bd	dc08	8808	c87c
ODE0	507c	147c	1c12	1212	1cf4	9494	94f7	be92
ODF0	9e92	be8e	888c	88ee	e080	e020	e0e7	9496
OE00	94e7	7454	7454	570e	0808	080e	efaf	efaa
OE10	a970	4848	4870	aeaa	ea4a	4ea0	a0a0	a0e0
OE20	f555	7555	f777	4272	1272	7645	6545	767f
OE30	5d7f	7f7f	7f7f	5d7f	f755	7755	f540	
OE40	4040	4074	7c50	7c14	7cf3	5171	55f7	5476
OE50	54f7	7724	2721	270e	0a0e	0808	8e88	8c88
OE60	eeee	a8ee	a2ae	e080	c080	e038	1010	5070
OE70	5070	5050	f0f0	f0f0	f0f0	f090	90b0	f848
OE80	5060	5048	fe00	4410	44b8	a8a8	a8b8	97d4
OE90	b694	9744	4454	546c	3925	2525	39dd	1191
OEA0	11dd	2040	8040	20f7	5577	55f5	4a6a	5b4a
OEB0	4a40	8000	8040	eeaa	ee8a	8aae	a8ee	424e
OEC0	a5b5	ada4	a5d5	15d5	55dd	ee2a	ee4a	2a97
OED0	d4b4	9497	7040	6040	7088	0830	2020	0020
OEE0	ee88	8ca8	eeef	a9af	zae9	7744	4654	7779
OEF0	2939	2979	2121	2121	3900	0000	00c0	--
OF00	stores	VO	to	VF	--	--	--	--
OF10	cards	--	work	area	--	--	--	--
OF20	top cards	--	bets	--	bank	bal.	--	--
OF30	george	bal.	--	bill	bal.	XXXXXXXXXXXXXX	XXXX	Storage of 4 decks of cards XXXXX

0600	0910	6001	620B	630A	26E6	6005	6307	26E6
0610	6000	630A	26E6	6006	6307	26E6	6004	6308
0620	26E6	6A00	6B00	00E0	A6D1	6C00	6D16	DCD2
0630	7D0B	DCD1	7C08	3C40	162C	A957	6D24	270C
0640	271C	3500	16D0	2752	26FA	6C00	6D00	C007
0650	4006	164E	4007	164E	A7EE	FC1E	F01E	F065
0660	A97A	FD1E	F055	7D01	7C06	3D07	164E	6007
0670	26E2	276E	6D1A	6F01	663C	2730	FF18	6E2E
0680	FE15	FE07	4605	2756	3E00	1682	2730	76FF
0690	3600	167A	FC18	276E	26FA	26E0	2708	276E
06A0	6C00	279E	6C1C	27CE	8890	6C22	279E	6C39
06B0	27CE	6E0E	60AA	F015	F007	FE00	EEA1	16AO
06C0	FE18	3000	16R8	8A84	8B94	FC00	FC18	1626
06D0	6FFF	FF15	FF07	FF00	FF18	3F35	16D4	1622
06E0	6000	6200	6300	6100	2920	7101	3108	16E8
06F0	7201	7301	330B	16E6	00EE	6C18	6D19	A8DC
0700	DCD7	7C06	DCD7	00EE	A8E8	6D1A	6C00	6305
0710	DCD5	F31E	7C08	3C38	1710	00EE	6500	6D2B
0720	86A0	27BA	6C08	2732	86B0	27BA	6C2A	1732
0730	6C1C	A981	F633	F265	4002	00EE	F029	3000
0740	2748	F129	2748	F229	DCD5	3D24	7C01	7C04
0750	00EE	6004	1758	6005	6103	275E	6104	620C
0760	6300	2920	7201	7301	3304	1762	00EE	6300
0770	6C00	6D00	A97A	F31E	F065	A818	F01E	DCD9
0780	7C12	7301	4307	00EE	3304	1774	6D0B	6C08
0790	1774	6100	3C00	7104	6215	6301	1762	6D2B
07A0	F70A	470A	17B2	370D	17A0	6000	2792	A90B
07B0	1748	6001	2792	A8E3	1748	6C9C	8064	3F01
07C0	00EE	7501	6C64	8C64	3F00	75FF	00EE	6D24
07D0	F00A	6100	4000	17DE	710A	70FF	17D4	F60A
07E0	8614	8960	370D	1732	8995	8965	1732	38AB
07F0	4070	451B	70AB	66BB	122F	1223	A32B	665E
0800	8196	0900	5578	451B	89B3	6791	4D9B	9167
0810	4D89	9167	9B4D	894D	8282	8282	FE10	1010
0820	1000	8142	2418	1824	4281	F088	8484	8484
0830	8488	F082	C2C2	A292	8A86	8682	8282	8282
0840	92AA	C682	C6AA	9282	8282	8282	C66C	3810
0850	F884	8488	F088	8484	F884	8484	F880	8080
0860	8080	8080	80FC	8080	80F0	8080	80FC	8080
0870	80F0	8080	8080	FE02	0408	1020	4080	FE10
0880	1010	1010	1010	1010	F884	8484	F8A0	9088
0890	8488	90A0	C0A0	9088	8478	8480	8080	8E84
08A0	8478	8484	8484	8478	8484	8484	84FC	8484
08B0	8484	FC84	8484	8484	8484	8478	8480	8080
08C0	8080	8478	8480	8078	0404	8478	8484	8484
08D0	8494	8C7E	0808	0808	0888	9060	3F3F	3F3F
08E0	3F3F	3F20	20F8	2020	E98D	CB89	E977	2426
08F0	2427	7848	7850	4877	4474	1477	334A	4B4A
0900	32DD	51D9	905D	C000	C040	C000	00F8	0000
0910	F839	AF96	BFEF	F82C	5F62	2FF8	205F	62D4
0920	A981	F255	0928	00EE	F809	BEF8	81AE	EE72
0930	FA07	BEFO	FA07	5E1E	FOFA	1FFE	FEFE	FE5E
0940	F80C	7C00	BDF8	80F4	AF9D	7C00	BD8F	2EF4
0950	ADED	9F5D	63E2	D4F7	84B6	94F7	7754	5755
0960	74BD	A1AD	25BD	C000	8000	C001	0000	0001
0970	E4A4	E4A4	E488	8888	88EE	--	--	--
0980	--	--	--	--	--	--	--	--

## SKEET SHOOT

Peter Collins, Springvale South Vic.

Undoubtedly, dedicated games players have seen skeet shoot in a games arcade where a missile (skeet) is fired at random across a screen and you have to predict where it is going to be and fire ahead of it so that you shoot the skeet. What you are doing, in fact, is judging the speed of the skeet and the speed of your shot so that they meet at a pre-judged point.

This version draws a 'T' channel on screen. Your shot is at the bottom of the T vertical and the skeet flies across the T horizontal. Simple? Sure is, but not so simple to hit the skeet!

### PRESS KEY 5 TO FIRE

The score is displayed on the lower left of the screen — you get 5 points per hit and the number of shots left is displayed on the lower right — you start off with 20 shots. (Best effort from the ETI staff was 65!)

```

0600 6400 6501 A720 D451 7401 343F 1606 643E
0610 6504 D451 74FF 3420 1612 D451 7501 352F
0620 161A D451 74FF 341D 1622 D451 75FF 3504
0630 162A D451 74FF 3400 1632 D451 75FF 3501
0640 163A 6401 6700 6814 26E0 26EA 6B00 6C02
0650 A722 DBC2 691E 6A2C A724 D9A2 4800 165E
0660 6E00 6680 6D05 EDA1 6600 3680 268C A722
0670 DBC2 8B44 DBC2 3F00 1694 4E00 165C A724
0680 D9A2 4A02 16C6 7AFF D9A2 166E 6E01 6D08
0690 FD18 00EE A722 DBC2 A724 3F01 D9A2 A724
06A0 D9A2 6506 6D02 FD18 6D03 FD15 FD07 3D00
06B0 16AC 75FF 3500 16A4 26E0 7705 26E0 26EA
06C0 78FF 26E0 164C 3F01 D9A2 7901 D9A2 493F
06D0 16D4 166E 3F01 D9A2 26EA 78FF 26EA 1654
06E0 A710 F733 6300 26F4 00EE A710 F833 6332
06F0 26F4 00EE 6D2B F265 F029 D3DS 7305 F129
0700 D3DS 7305 F229 D3DS 00EE
0720 8000 3030 COCO
    
```

## METEOR STORM

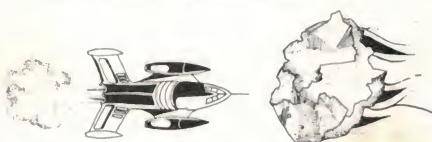
Adrian Ollerenshaw, O'Sullivan Beach SA.

Dodge the meteors! Here you are, hurtling through space and dirty great meteors bear down on you — what to do, duck out of the way or shoot them down? Well, that depends on the position in which you find yourself. Getting hit means your ship is destroyed. Blasting meteors wins you points. Here's how to control your ship:

MOVE UP	press KEY 0
MOVE DOWN	press KEY 1
TO FIRE	press KEY F

When the game starts, your ship appears on the centre left of the screen. Meteors rush at you from the right hand side of the screen. You can only afford to lose three ships in crashes, at which point the game ends. If you successfully destroy 20 or more meteors you get another ship. The score is displayed at the end of the game (i.e.: after three crashes). Note that, after firing, you can direct your missile by moving your ship up and down.

To start a new game, simply press any key.



## BLOCK PUZZLE

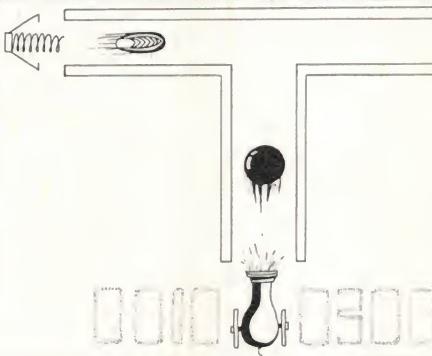
David Poole, Kenthurst NSW

This is a simulation of the traditional block puzzles everyone used to play at school under the desk while the teacher's back was turned. Block puzzles consist of a matrix of interlocking tablets, usually in a square of 4 x 4 or 5 x 5, with one tablet missing allowing you to shuffle the tablets or blocks. Each block has a numeral or letter and the object is to arrange them in order: 1 2 3 4 in the first row, 6 7 8 9 in the second row etc, leaving the blank in one corner. There are various other arrangements, but you get the idea.

This version displays 16 white blocks on the screen in a 4 x 4 matrix with a numeral or letter in 15, one being blank. You get the numerals 1 to 9 and letters A to F. You can move the blank by pressing the keys as follows:

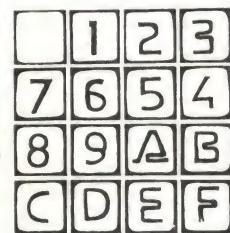
UP	press KEY 2
DOWN	press KEY 8
LEFT	press KEY 6
RIGHT	press KEY 4

When you start the program, the block puzzle is written on the screen and the computer randomly shuffles all the blocks. When it stops, you can start moving the blank. This game is guaranteed to take longer to play than it is to key in!



```

0600 6A12 6B01 6110 6200 6000 A6B0 D127 F029
0610 3000 DABS 7108 7A08 3130 1624 6110 7208
0620 6A12 7B08 A700 F055 7001 3010 160A
0630 6A12 6B01 6C00 62FF C006 7002 2652 72FF
0640 3200 1638 6E00 00FF F00A 2652 7E01 00FF
0650 1648 84A0 65B0 86C0 3002 1664 4501 1664
0660 75F8 76FC 3008 1670 4519 1670 7508 7604
0678 3006 167C 4412 167C 74F8 76FF 3004 1688
0680 442A 1688 7408 7601 A700 F61E F065 8100
0690 6000 A700 F61E F055 A700 FC1E 8010 F055
06A0 F129 D455 DAB5 8A40 8B50 8C60 00EE EEE5
06B0 FEFE FEFE FEFE FEFE
    
```



## SPACE INVADERS MK III

Peter Collins has modified the original '660 Invaders (Feb. '82, p.116) to give it a few interesting twists.

You get a 'tank' or 'ship' at the base of the screen and a single 'invader' ship moves from left to right across the top of the screen. However, in this version, you can move your tank, rather than firing at angles. The following keys are used:

MOVE LEFT	KEY 4
MOVE RIGHT	KEY 6
FIRE	KEY 5

It looks simple, doesn't it? However, the invader slows down and speeds up in order to avoid your shot! Very cunning!

You can't move while shooting. Note that your tank 'wraps around' the screen if you move off-screen on either side.

You start off with an arsenal of 20 shots and score 10 for each hit. The score is displayed at lower left, shots to go at lower right.

You can hit the invader more than once as it progresses across the screen by chasing after it and firing at the appropriate moment.

Get after it!

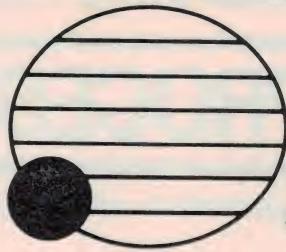
(Alright all you CHIP 8 hackers — this one is ripe for 'colouring up', adding sound effects etc. How about it? Don't forget, we pay for programs published — Ed.)

```

0600 6900 6803 6A06 6B0E 630A 6410 6E00 6700
0610 6120 A732 DAB5 6600 E6A1 16B6 6601 E6A1
0620 16D6 660F 3701 162C 2680 1630 E6A1 26F6
0630 A732 DAB5 6F00 DAB5 3F01 163E 16FE 4E01
0640 2658 4701 2680 3E01 164C 1616 6C39 CD19
0650 A736 DCD7 6E01 1616 C207 4201 1664 4205
0660 1678 1658 A736 DCD7 7D01 7CFC 3C01 1674
0670 6E00 00EE DCD7 00EE A736 DCD7 7DFF 166A
0680 A744 D341 6F00 7301 3340 1692 6700 630A
0690 00EE D341 3F01 00EE 00E0 7901 A732 DAB5
06A0 A73E DCD5 6E00 6700 630A F118 3914 16B2
06B0 7801 00E0 1746 3701 16C4 A744 D341 74FF
06C0 D341 16C6 74FF A732 DAB5 7BFF 6F00 DAB5
06D0 3F01 161C 16FE 3701 16E4 A744 D341 7401
06E0 D341 16E6 7401 A732 DAB5 6F00 7B01 DAB5
06F0 3F01 1622 16FE A744 D341 6701 00EE 00E0
0700 A73D DAB7 F118 00E0 78FF 3800 1604 A754
0710 F933 F265 6A15 6B0F F029 272C F129 272C
0720 F229 272C FA18 F10A 00E0 1600 DAB5 7A04
0730 00EE 38E0 70E0 386C FEAA FE6C 3882 4428
0740 0028 4482 8000 A732 DAB5 6F00 630A 6E00
0750 6700 00EE
    
```

```

0600 A68C 6B00 6C05 DBC3 641E 6523 6700 6814
0610 268C 269A A688 D454 4800 1618 6E00 6680
0620 3F01 D454 6D04 EDA1 74FF 6D06 EDA1 7401
0630 6D05 EDA1 6600 3680 2676 A68C DBC3 CD01
0640 8BD4 DBC3 3F00 165E 4E00 1614 2682 A68F
0650 D9A1 4A00 1668 7AFF D9A1 2682 163A 2690
0660 770A 2690 A68F D9A1 267C D9A1 6D03 FD18
0670 269A 78FF 1612 6E01 6D08 FD18 8940 8A50
0680 00EE A688 D454 00EE 1038 7C54 60F0 6010
0690 A6F8 F733 6300 26A4 00EE A6F8 F833 6332
06A0 26A4 00EE 6D2B F265 F029 D3DS 7305 F129
06B0 D3DS 7305 F229 D3DS 00EE
    
```

**RIZ**

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**\$4950 + TAX**

**TECHNICAL SPECIFICATIONS:**

CPU:	8088, 5 MHz
Memory	128k (64k dynamic RAM chips) internally expandable to 512 kbytes; external module to expand to 1 Mbyte
Keyboard	95 keys inc. 7 prog. function keys, numeric pad, cursor control, editing, screen & loudspeaker control, all software re-definable.
Screen	80 char x 25 lines; hi-res graphics, 800 x 400 bit-mapped, user-definable character sets.
Disk drives	2 x 5 1/4in single-sided, high density, 600 kbytes per unit.
Ports	1 Centronics/IEEE-488 printer port, 1 RS232 printer port, 1 RS232 communications port.
System Software Languages	CP/M-86 and MSDOS Basic 86; Graphics & character set packages. Assembler, Fortran, Cobol, Pascal, PL-I, Extended business basic compiler, various applications software.



## **software price list**

The Sirius comes complete with CP/MI-86, MS-DOS & M Basic

CBASIC (Digital Research)	\$440	SELECT (Select)	\$550
Report Manager (Image)	\$330	SuperCalc (Sorcim)	\$330
Time Manager (Image) (a)	\$225	Pascal/M (Sorcim)	\$550
Personnel Manager (Image) (a)	\$225	Basic Interpreter (Microsoft)	\$440
Project Manager (Image) (a)	\$225	Basic Compiler Diskette	\$550
Level II COBOL with Forms 2 (Microfocus)	\$1125	COBOL (Microsoft)	\$880
WordStar (MicroPro)	\$550	Multiplan (Microsoft)	\$330
WordStar with MailMerge (MicroPro)	\$775	Pascal (Microsoft)	\$660
WordStar with SpellStar (MicroPro)	\$880	Fortran (Microsoft)	\$550
WordStar with MailMerge and SpellStar (MicroPro)	\$1125	Real Estate Package (Sample printout available)	\$1500
SuperSort (MicroPro)	\$280	Medical Package (Sample printout available)	\$1500
WordMaster (MicroPro)	\$175	Debtors & Creditors	\$1500
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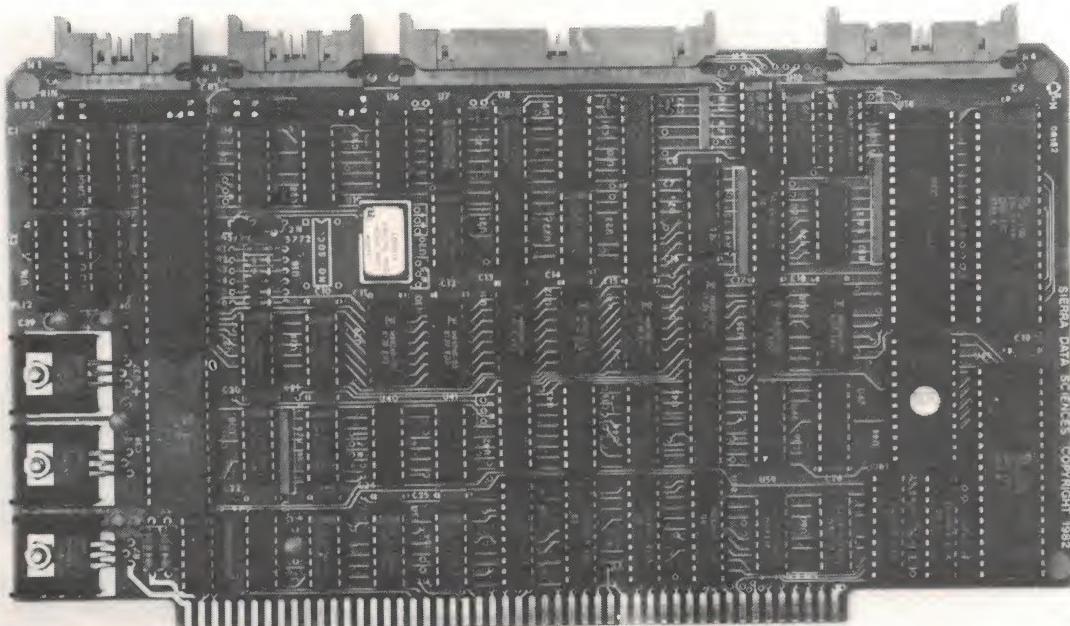
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# SBC100 MASTER PROCESSOR

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- Two parallel ports (Z-80A PIO)
- NEC 765 floppy disc controller supports 4, 203 mm drives double sided, double density.
- 64K RAM (no wait states)
- 2732 4K EPROM supplied with system executive, may be switched out under software control.
- Intelligent Winchester interface (optional).
- IEEE 696 S100 standard interface.
- Software programmable baud rates.
- Time-of-day clock.
- Will operate stand-alone.
- Expandable into multi-user and hard disk systems.
- 4-layer PCB, all IC's socketed, high quality construction.

The Sierra Data Sciences SBC100 Master Processor is the first S100 single board computer that provides all resources necessary to run CP/M.

Standard features provided are an RS232 terminal port; a serial printer port; two parallel ports that may be used as a Centronics or intelligent Winchester interface; a floppy disc controller; 64K of memory; and a Z-80A running at 4MHz. A sophisticated CP/M implementation designed to make use of all the features of this board is also available.

While perfect for single user environments, this board was designed to be equally suitable for both time-sliced and multi-processor networking systems. A satellite processor card, the SBC100S, has been designed to assist in multi-processor implementations. As data transfers are via I/O ports on the S100 bus, it can be used with other host processors, even 16-bit machines. A full implementation of the powerful TURBODOS multi-user operating system is available.

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# Native technology — the Mirror Systems 2000 computer



Here is a locally designed and manufactured personal computer with some unusual features not seen elsewhere.

**Jonathan Scott**

THE MIRROR SYSTEMS model 2000 is a 6502-based personal computer which boasts a number of interesting features in its design which set it apart from the run-of-the-mill type machines. The most significant difference is that it has software-driven graphics. 'What?', I hear you say. This means that the processor itself is sending the data out to the TV monitor for display. In the Mirror 2000, a timer interrupts the processor using its NMI (Non-Maskable Interrupt) line at the required moments, and it outputs the bits to the screen.

The first benefit the makers boast is a low parts count. This should lead to low cost and high reliability. Indeed, the parts count is low for such a computer. The board itself sells for \$379, while the works (tested working board, 8K RAM, power supply, enclosure, basic ROMs and speaker) comes in at \$599 + \$10

&p from the manufacturers. Considering what is offering these days, we rather expected the bare board to be around the \$250 mark, in view of its low parts count and unextraordinary hardware. We might add that while the single 380 by 270 mm pc board is of the plain tinned and plated-through hole type, the keyboard, which occupies about 30% of the area, is a neat and very nice-feeling design.

The next benefit of software-implemented video control is extreme flexibility in the display system. In this the Mirror is unequalled in home machines. The makers promise a colour output board (the basic unit is B&W only) which, when it arrives, will give superb capabilities. As is, it starts with a video format of 24 lines of 44 characters each in a 5 x 7 matrix. This can be user-programmed to 32 lines, though we did

not try this to see how it appeared. As the character generator is soft, it is an elementary (machine level) job to produce whatever character setup you desire — e.g: a full 7 x 12 dot matrix character set with descenders, as found on the high level type of machine. We received an example program which allows you to build a character set like using lego bricks. This is really not the type of job one would want to do himself, so we feel that such software should be available, and no doubt will be if the machine finds a large market. The other luxury item in the flexible video line is smooth scrolling. This is actually supported at BASIC level, by one of the extension commands, which we will discuss later. In a single command the screen scrolling may be slowed or hastened, giving either a brisk or a visually pleasing movement of lines on ►

the screen, as the user desires. The character generators may be exchanged, turned off and on or modified as you go, since their location is also changeable. In fact we were most pleased by the number of factors which were not only designed in such a way as to allow them to be changed at the whim of the user, but also pointed out in the manual supplied with the system. The programmer of the Mirror has not fallen into the trap of keeping things you might want to change to himself, or keeping them where you cannot get at them.

## Graphics

The graphics part of the operation is just as variable. It starts out as a 248 pixel wide by 128 pixel high operation. In actual fact this is implemented as if there were 31 *very* high characters on the screen, though this fact is substantially transparent to the BASIC user. This occupies the top half of the screen, which is rather disconcerting at first, as the bottom is blank. We feel the unit should have possibly been organised to default a lower screen of text, given that the upper half is all that is required for graphics. This brings us to another quibble of this machine, namely the memory. In these days of plummeting memory prices and comprehensive memory-burning programs ('Adventure' and so on in the games sphere and 'relaxation' programs in the technical) the Mirror is rather small. Sporting space for sixteen 2114 ICs (8K) on the pc board, further memory has to be outboard. The manufacturers intend these boards to be available in the future. The graphics can of course be changed to fill

the whole screen, 256 x 256 pixels, but there goes 8K, a lot of memory for this beast. (That's in B&W too!)

The colour board which we mentioned earlier promises to give very good colour capability indeed, when and if it arrives. Slated for release 'when demand becomes sufficient', it will allocate three bits per pixel, giving eight colours, but each of these eight choices can be programmed to one of 4096 different colours, presumably constructed by choosing one of 16 levels of intensity for each of the prime colours. This, if it lives up to expectations, represents very fine and powerful games-type or diagrammatic graphics indeed.

## BASIC

The basic BASIC is Synertek 8K, but the Mirror has an extension set consisting of ten graphics associated commands, two printer (RS232) commands and a sound port command. The graphics commands allow clearing of the screen, setting and reading of pixels, setting graphics, video or no output to the screen, (the turnoff facility being used for speed), adjusting scrolling speed, moving the cursor for print and input statements, drawing lines and circles and 'filling in' shapes on the graphics platen. These commands seem very comprehensive and well worked out, easing the job of drawing immensely, but there is one quibble that we have regarding the circle command. The length of arc which is drawn, i.e: the fraction of a whole circle, is specified in terms of the number of pixels of circumference to be filled in, rather than in terms of the angle subtended by the required arc.

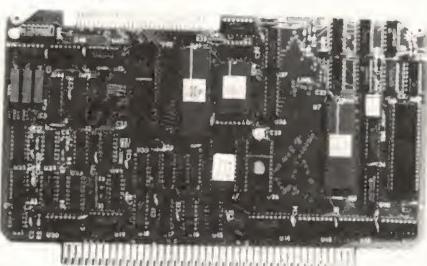
We were particularly pleased with the 'PAINT' command, which does the filling. This merely turns all the pixels within an enclosed shape to the specified state. We rather expected it to fail on re-entrant shapes, such as a boomerang placed horizontally, but it did not fall into this trap. After a while we thought of some commands which it would have been nice to add if you are going to the trouble of extending the BASIC, but which were not included. In fact, it is a strong selling point of the MicroBee that it has a very extended BASIC which is clearly influenced by the design philosophies of Hewlett Packard computers with which the author has worked. The idea of extending BASIC is a good one, and few of the computers we have seen even bother. Once having gone to the trouble of interfacing to the core routines however, the more extensions, the classier a machine results. We would be pleased and not surprised if popularity of Mirror 2000's saw the availability of a ROM or program to extend further.

The printer commands are simply 'LPRINT' and 'LLIST' which print or list to the RS232 interface — nothing surprising, but useful utilities. The sound command is a little unusual, by virtue of the method of sound output. The Mirror clocks an 8-bit shift register out to the speaker. The 'PLAY' command accepts as its parameters a duration number (16 bits, in decimal integer form) and a value representing the eight bits to be loaded and clocked out. Frequencies between 1.9 kHz and 7.5 kHz may be generated. The lower limit is rather painful, compared to other machines as tones which sound pleasant are generally below 1 kHz.

## 68PDC04

### Processor and Disc Controller Card

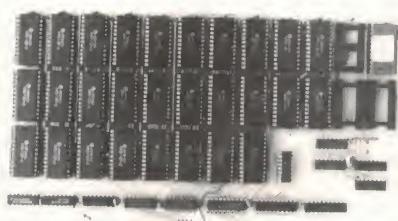
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The Mirror 2000 exposed! All enquiries about this computer should be directed to Mirror Systems, P.O. Box 186, Belmont Vic. 3216.

There is a possibility which we did not explore, that tones of lower frequency could be generated at machine level using single cycles of the shift register. This might have been supported by the BASIC level command. Also the units of the duration parameter are not mentioned, one of the few flaws of the manual supplied. (They turn out to be a shade more than 1 ms, as might be expected.)

### The editor

The system also has an on-screen editor. This is a very neat system, being of the popular type where control keys move a cursor over the screen and allow characters over which the cursor passes to be fed into the input line where resides the normal input cursor. This allows lines previously listed to be copied in with additions, concatenations (stringing things together) or deletions as required. More powerful editors are not found on domestic type machines in general, and most do not have editors as standard anyway. The keys are easy to recall, and we experienced no problems whatsoever with this system. Very laudable.

### Monitor

A monitor is included, which supports inspection, modification, execution and saving/loading of machine level blocks. This is a fairly standard setup, which we will not dwell on. Suffice to say that it is fine for a quick check of machine language routines which are small, but a more comprehensive system would be needed if one was to want to do any significant amount of programming at the 6502 native level.

### Cassette interface

The cassette interface for recording and recalling programs is fairly standard, except that it does have the facility to load a particular program identified by a number at the time of saving. A 'LOAD' command will not load another program if it is set to load number 4, say. So if you lose the location on the tape of number 4, the tape need only be played end to end while a 'LOAD 4' is in effect, and the Mirror will wait and grab that one from the others. Of course, it can be set to load the first it comes to, if you forget the number.

### Expansion

Finally to the matter of expansion. At this time, the Mirror appears not to be supported by any expansion boards which can be immediately plugged in to give more memory, a disk drive, etc. The board is provided with a very complete 40 pin expansion socket with buffered address and data lines, clock and control lines. This is clearly designed with expansion in mind, so the possibility is there, but we feel that the lack of boards on the market is rather a failure. A 20-pin RCA type keyboard connection is also provided, for external input of keystroke data. We would like to see the promised colour board and more memory, and perhaps some interface board to make an extant disk drive, such as the Apple-type drives, immediately compatible. These will be available if the Mirror becomes popular, and will be purchased even if they are not so cheap, but the initial unit is rather costly for the parts used, and it seems to us that the price will hinder the deserved popularity of this machine.

# ...and for good measure...

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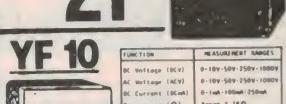
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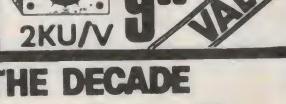
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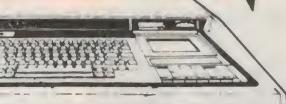
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# The pocket programmer's friend

A utility package for the Sharp and Tandy pocket computers. The program assumes that the user has access to a bigger system and likes to program it in machine code.

**Tom Moffat**

PEOPLE HAVE TRADITIONALLY used the decimal number system, based on ten, because it matches the number of fingers they have to count on. Computers demand binary since their internal registers can only exist in two states. Then there's hexadecimal, a more convenient way of expressing binary, using sixteen states. Anyone who can count hexadecimal on his fingers should forget about computers and join the nearest circus.

The first three routines convert numbers from one system to another. In the pocket computer all the routines are called up in the 'defined' mode, by hitting 'SHIFT' and then the appropriate letter, 'B', 'D', 'H', 'Z' or 'X'.

B, D and H specify the number system being converted from. The computer will respond with 'CONVERT TO:' and you again enter B, D or H.

## Program 'B' (convert from binary)

You enter either 8 or 16 bits, 8 bits at a time, as 1's and 0's. If an 8 bit number, enter '0' for byte 1 and then the 8 bits for byte 0. After a (somewhat lengthy) pause the computer will beep and then deliver the decimal or hexadecimal equivalent. For another number hit 'SHIFT B' again.

## Program 'D' (convert from decimal)

As the program is limited to sixteen bits the highest decimal number you can enter is 65 535 which represents all 16 bits high. Enter the number in the normal way, and wait for the result as above.



## Program 'H' (convert from hexadecimal)

The pocket computer doesn't split strings, so you must do it yourself. Enter four hex digits separately, such as "0-ENTER -2- ENTER -A- ENTER -B-ENTER" for '02AB'. The conversion will appear in due course, after a beep.

## Program 'Z'

This is not a number converter, but it's probably the most useful routine of all. Without going into machine code programming too deeply, it can be said that it's sometimes necessary to execute certain program steps 'out of order', usually conditional on the result of some test. If you're at some memory address and want to jump to another address, the actual instruction doesn't usually say *where* to jump; it only says how far and in what direction.

In this program you enter the 'FROM' and 'TO' addresses (in four digit hexadecimal, as in program 'H'), and the computer responds with '00xx' where 'xx' are the hex digits to be used in the

actual instruction. Microprocessors limit the jump distance (called the 'offset' or the 'displacement') to between -128 and +127 bytes.

Any attempt to calculate further than this on the pocket computer will result in an 'OUT OF RANGE' message, and usually much swearing on the part of the programmer.

## Program 'X'

This does the opposite of program 'Z' and is handy for working out how other people wrote their programs. You supply the current address and the offset, and the computer tells you the address to be branched to.

When running the above routines you will notice they are painfully slow, but this is the price of heavy number crunching in the pocket computer. They will allow you to work independently of your bigger system; for instance at the office, when you're supposed to be doing something else (be sure to disable the BEEP statements in this case).

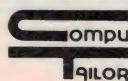
TELETYPE	POCKET COMPUTER
:	;
USING 'XXX'	USING "###"
.	*
LT	<
GT	>
P/R	^

## Program Listing

```

10: 'B'GOSUB 640
20: INPUT 'ENTER BYTE 1: ',U
30: INPUT 'ENTER BYTE 0: ',V
40: R=10:S=2
50: IF U LET X=U:GOSUB 600:U=256Y
60: X=V:GOSUB 600:T=U+Y
70: IF Q$='H' LET X=T:GOTO 300
80: BEEP 1:GOSUB 650:END
100: 'D'GOSUB 640:INPUT 'ENTER DECIMAL: ',V
110: IF Q$='H' LET X=V:GOTO 300
120: R=2:S=10
130: X= INT (V/256):IF X=0 THEN 150
140: GOSUB 600:T=Y
150: X=V:GOSUB 600:U=Y:BEEP 1
160: USING 'XXXXXXXXXX':PRINT 'BINARY':,T:,U
170: END
200: 'H'GOSUB 640
210: A=10:B=11:C=12:D=13:E=14:F=15
220: INPUT 'ENTER HEX: ',G,H,I,J
230: V=((16G+H) . 16+I) . 16+J
240: IF Q$='B' THEN 120
250: IF Q$='A' RETURN
260: T=V:BEEP.1:GOSUB 650
270: END
300: A$='0':B$='1':C$='2':D$='3'
301: E$='4':F$='5':G$='6':H$='7'
302: I$='8':J$='9':K$='A':L$='B'
303: M$='C':N$='D':O$='E':P$='F'
310: X=X/4096:Q= INT X
320: X=(X-Q) . 16:R= INT X
330: X=(X-R) . 16:S= INT X
340: X=(X-S) . 16:T= INT (X+.5)
350: Q=Q+1:R=R+1:S=S+1:T=T+1:BEEP 1
360: PRINT 'HEX= ',A$(Q):,A$(R):,A$(S):,A$(T)
370: END
400: '2'Q$='A':PAUSE 'FROM...'
410: GOSUB 210:K=V+2
420: PAUSE 'TO...'
430: GOSUB 220:L=V
440: M=L-K:IF (M LT -128)+(M GT 127)PAUSE
      'OUT OF RANGE.':GOTO 400
450: IF M LT 0 LET M=M+256
460: X=M:GOTO 300
500: 'X'Q$='A':PAUSE 'CURRENT ADDRESS...'
510: GOSUB 210:K=V+2
520: PAUSE 'OFFSET VALUE...'
530: GOSUB 220:L=V
540: IF L GT 127 LET L=L-256
550: M=K+L:X=M:GOTO 300
600: Y=0:FOR W=0 TO 7
610: Z= INT (X/R)
620: Y=Y+(X-RZ) . S PWR W:X=Z
630: NEXT W:RETURN
640: CLEAR:INPUT 'CONVERT TO: ',Q$:RETURN
650: USING 'XXXXXX':PRINT 'DECIMAL':,T:RETURN

```



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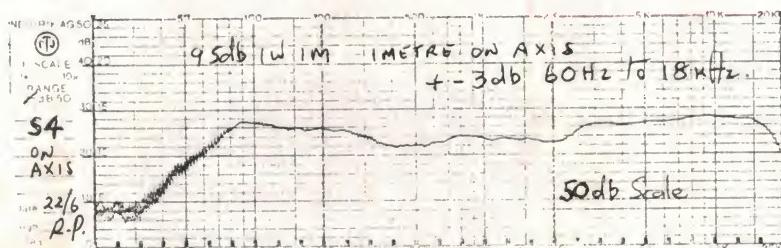


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However . . . beware the imitators. They offer price but not quality. Only the finest materials are used in producing Monster Cable. And it is safe to use with all amplifiers, regardless of design.

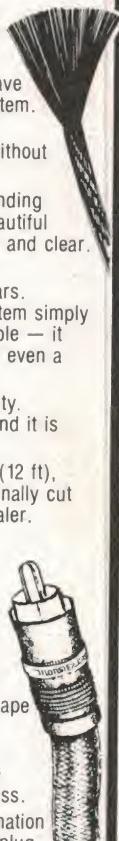
Monster Cable is available conveniently pre-packed in 3.7 metre (12 ft), 6.1 metre (20 ft) and 9.1 metre (30 ft) pairs, or can be professionally cut and terminated in custom lengths at your local Monster Cable dealer.

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Designed specifically for transmitting low level audio signals, Interlink sets a new standard of performance and value in interconnect cables — for turntables, pre-amplifiers, tuners and tape decks. (And video equipment as well.)

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Sonically, Interlink/Phonolink combine to maximise your sound system's performance for increased clarity, greater dynamic range, lower distortion and reduced hum and RF interference.

Interlink/Phonolink is available in pre-packaged 1 metre pairs or can be cut and terminated to the exact length you require by your Performance Standard Series dealer.

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# ELECTRONIC LIFESTYLE

## Grand Hi-Fi Contest winners!

Our Grand Hi-Fi Contest, run over the July and August issues, was a great success, thanks to the many, many readers who tackled the dozen twisty questions with gusto and ingenuity. Here are the answers:

1) The Gregorian Calendar was adopted by Roman Catholic countries in 1582 but it wasn't until 1752 that Britain followed suit. The discrepancy between the prevailing Julian calendar and the Gregorian calendar was then 11 days. The 1751 Act required that "the Natural Day next immediately following the second Day of September (1752) shall be called, reckoned and accounted to be the fourteenth Day of September . . .".

Thus there **were** no dates between the 3rd and 13th of September 1752 hence no significant discoveries were made.

2) Three hours after Bell filed his telephone apparatus patent, Elisha Gray filed a caveat with the US Patent Office claiming that he was working on a similar device.

3) In 1857 Leon Scott (known also as Leon Scott de Martinville and in another reference as Edouard Leon-Scott) developed his 'phonautograph' which employed a hog bristle to trace sound vibrations on carbon-blackened paper.

4) Hollerith's first punched cards were 6½" by 3¼" — the same size as the then US dollar bill. His adoption of that size enabled him to use existing bill handling equipment.

5) Unlikely though it may seem, the circuit shown in this question was an early heterodyne radio receiver. The dc energised arc, C1, L3/4 forms a local oscillator. (After Fessenden.)

6) A 'Rheotome' was essentially a device for continuously interrupting the flow of current in an electrical circuit. In 1854 Lenz used such a device for measuring voltage waveforms of ac generators. Bell used another during his pioneering work on the multiple telegraph.

7) Nathaniel Hawthorne in 'House of Seven Gables' wrote "Is it a fact — or have I dreamt it — that, by means of electricity, the world of matter has become a great nerve, vibrating thousands of miles in a breathless point of time?"

8) In 1792 leaders of the French Revolutionary Convention introduced a decimal calendar. Whilst still retaining 12 months a year each month consisted of three weeks, each of ten days. Each day was divided into ten hours, each hour into 100 minutes and each minute into 100 seconds. The remaining days were inserted as holidays (the Sansculottides) at the end of each year. The decimal day survived from 1793 until 1795 but the decimal calendar continued until January 1st 1806 when Napoleon changed back to the Gregorian system.

9) Our illustration is of Augustus de Morgan. Together with George Boole, de Morgan developed theorems used to simplify expressions of logical variables using what became known as 'Boolean algebra' notation.

10) This question, concerning the discovery of the thermoelectric effect by people other than T.J. Seebeck has proved slightly controversial. James Cumming and Jean-Phillibert Dessaigne were the people we had in mind. Several contestants have provided evidence that whilst literature credits Cumming and Dessaigne with independent and/or anticipated discovery the extent of their work is in some doubt. Nevertheless as these are the only two people named who could be considered in the context of the question we feel that it is fair to retain those as the correct answers.

11) In 1843 Alexander Bain received British Patent 9745 for his automatic electrochemical recording telegraph.

12) Babbage's signalling lamp (using occulting solar lights) was used by the Russians during the Seige of Sebastopol.

**First prize** goes to Mr. G.M. Stallman of Graceville in Queensland. No doubt you'll enjoy your system compiled from equipment supplied by Audio Engineers, Concept Audio, Communications Power Inc, National Technics, TDK, Marantz, Pioneer, Vanfi, Audioson, Convoy and Maurice Chapman.

**Second prize** goes to A.G. Wood of Sydney NSW. We guess you'll be pleased with the Sharp VZ2000 portable hi-fi plus Allsop accessories, TDK tape and Sennheiser headphones from R.H. Cunningham.

**Consolation prizes**, in order, went to W. Pantelejenko of Plenty Vic; Wayne Thompson of Croydon Vic; Peter Farleigh of Peakhurst NSW; T. Krysiak of Mt Hawthorn WA; Peter Kelly of Leonay NSW and Michael Reich of Turner ACT. The consolation prizes comprised items donated by Communications Power Inc (Allsop accessories), R.H. Cunningham (Sennheiser headphones), TDK (cassette tapes) and Maurice Chapman (Audio-Technica cartridges).

**The six runners-up** were Roy Preece and Chris Davies of Carlton Vic; Ray Johnson of Stanmore NSW; R.C. Neale of Killara NSW; B.F. Pollett of Cheltenham Vic. and Fred Inman of Cottonvale Qld. Fred Inman deserves special mention as he received a runner-up prize for the most imaginative entry sent in. To question 3, he said "Tom Tom the Piper's Son used a diaphragm and hog bristle to develop a (sex aid)!" To question 4 he said Hollerith's cards were 5'8" by 3' to "simulate the height and width of his mother in law for more precise punching practice." The circuit in question 5 Fred said was "a lightning powered ear wax dislodger with 110 V (light duty) battery charger." For question 8, he said "DeciBelgium" introduced decimal time in "Dec. 1010." Instead of telling us the picture in question 9 was that of de Morgan, he said it was "W.C. Shop — he invented the shop counter." Having provided everyone with such a good laugh we thought it was worth something.

Thank you to all the firms who donated prizes and thank you to all the enthusiastic contest entrants. We're sincerely glad you enjoyed the challenge of another of our famous twisty questions contests and hope you search the magazine keenly for more (. . . like the one on page 27, this issue).

# *a step beyond extraordinary*



## *the V15 type V*

A revolutionary phono cartridge design that recreates the music... and brings back the emotion of the performance!

- **BERYLLIUM MICROWALL/BETM STYLUS SHANK**  
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Verifies your Cartridge's performance.

Total Trackability Index Test Record also available.

For technical service and advice, contact the Audio Engineers representative at the office in your State:

## *Specifications:*

Optimum	10 mN (1.0 gram)	Total Tone Arm Setting With Dynamic Stabiliser Operating
Maximum	12.5 mN	15mN (1.5 grams) 17.5 mN (1.75 grams)
		(1.25 grams)

**Force Exerted By Dynamic Stabiliser:** 5 mN (0.5 grams)

**Tip Geometry (Typical):** Hypere elliptical,  $5\mu \times 38\mu$  (0.2 mil  $\times$  1.5 mil) long contact

**Trackability At 10 mN (1 gram) Tracking Force (Typical in cm/sec peak velocity):**

400Hz: 30cm/sec	5kHz: 80cm/sec
1kHz: 46cm/sec	10kHz: 60cm/sec

**Total Trackability Index (TTI):** 91.7 minimum

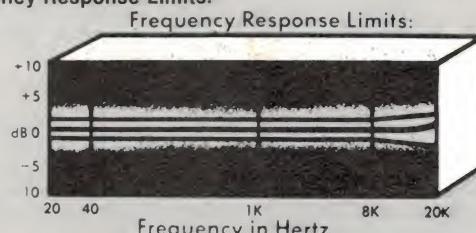
**Vertical Tone Arm Resonance:** Less than 5dB rise at 14Hz in SME Series III Tone Arm (without SME damper)

**Channel Balance:** Within 1.5dB

**Channel Separation:** 1kHz: 25dB or greater  
10kHz: 18dB or greater

**Output Voltage (Typical):** 3.2mV RMS at 1kHz at 5cm/sec peak velocity

**Frequency Response Limits:**



**Recommended Load:** 47 kohms in parallel with 250pF (includes tone arm wiring, connecting cables, and preamplifier input)  
Capacitive loading from 100pF to 400pF will cause negligible change from the recommended 250pF loading

**Resistance (Typical):** 815 ohms, dc

**Inductance (Typical):** 330mH at 1kHz

**Cartridge Weight:** 6.6 grams

**Replacement Stylus:** V15V: VN5HE, Nude Hyperelliptical tip,  $5 \times 38\mu$  (.0002  $\times$  .0015 in) Black serial numbers  
V15V-G: VN5G, Nude Spherical tip,  $15\mu$  (.0006 in) Red serial numbers

**Optional 78 RPM Stylus:** VN578E, Biradial (Elliptical) tip,  $13 \times 63\mu$  (.0005  $\times$  .0025 in)

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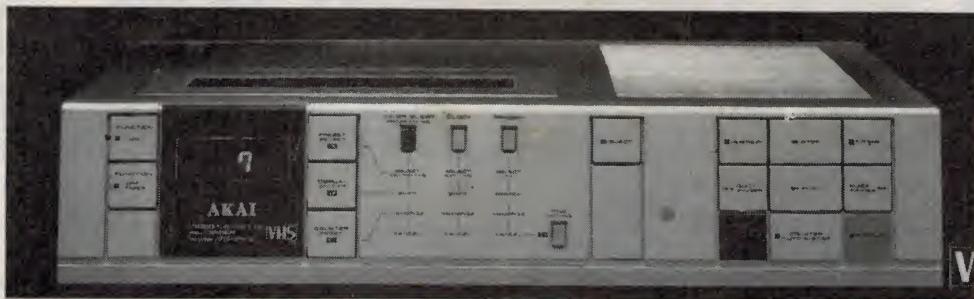
# LIFESTYLE NEWS

## Akai VS-2 video cassette recorder

The Akai VS-2 features full function wireless remote control and an interactive monitor system.

The interactive monitor system is a microcomputer based system that allows any TV screen to display VS-2 operating instructions, making operating an error-free process. The screen displays the unattended recording schedule and prompts for data input, updating or simple confirmation.

The VS-2 permits unattended recording of up to nine individual programmes on any combination of 16 different preset channels over a four week period.



## Granitic gramophone rocks on

A hi-fi gramophone with radically new technology has been put on the market by a small English electronics firm, Elite Townshend. Cranfield Institute of Technology's Unit for Precision Engineering designed the 'Rock' gramophone, but not without their share of problems.

It's called the Rock gramophone because it's filled with artificial granite to damp unwanted resonances and weighs 16 kg. It incorporates technology that Jack Dinsdale, a senior lecturer at Cranfield, developed. But the Rock cannot incorporate a special bearing that Dinsdale designed and patented because the patent rights were sold to another company — which has never exploited them.

The damping material, called Granitan, was developed at Cranfield.

It is as stiff as cast iron but is ten times better for damping spurious vibrations which can colour the sound from the pickup cartridge. Seven kilogrammes of Granitan are poured into the Rock's chassis during manufacture.

Another Cranfield invention damps vibrations in the pickup arm. A paddle on the arm has to move through oil in a thin trough mounted over the record. This kills off all vibrations of audible frequency.

## Have you seen the Michell Gyrodec?

Backed by the experience of many years of building high quality turntables such as the 'Reference' and 'Focus One', John Michell has now come up with a new design called the 'Gyrodec'.

The Michell Gyrodec represents the British interpretation of turntable state-of-the-art. Its detailed engineering is aimed at maximising isolation of the groove/stylus interface, to extract maximum information with minimum distortion. The Gyrodec is therefore equipped with a very specialised mat and clamping system, with a critically-aligned sub-chassis suspension to give exceptional independence of environmental vibration. The suspension is factory adjusted and arms of different weights are compensated by the use of specially weighted mounting plates, pre-drilled for accurate geometrical alignment for a wide range of popular models.

There is also provision for mounting a second arm should this be

required.

Short and long term rotational stability is ensured by the use of a very powerful low-voltage synchronous motor driving the massive peripherally-weighted platter via a resilient round-section belt.

The Gyrodec is therefore extremely simple to install and operate and needs no special procedure for setting up, other than correct assembly, to give best possible performance.

The Gyrodec is manufactured from aluminium, brass and clear acrylic.

Full information can be obtained from specialist retailers or Audio 2000, P.O. Box 107, Brookvale NSW 2100. (02)939-2159.

## Ampex awarded \$10M in magnetic tape contracts

Ampex Corporation USA recently announced that the General Services Administration has awarded the company two contracts valued at \$10 million to provide recording tape in support of all facets of US Government's magnetic tape requirements.

According to Stanley W. Faught, Vice President and General Manager of the Ampex Magnetic Tape Division, a \$7.4 million contract award is for precision instrumentation recording tape, which will be used in a variety of government-sponsored scientific research programmes, including the space shuttle and other deep space missions. It marks the

eleventh consecutive year Ampex has provided the GSA with instrumentation tape under the Federal Supply Schedule.

The other contract is a multiple \$2.6 million award to supply the GSA with broadcast video, video cassettes, audio cassettes, open reel audio and mastering tapes.

## Meridian M10 speaker system

Audio 2000 has the new Meridian M10 speaker system, the latest in the range of inter-active speakers by Boothroyd-Stuart. The other models in the family of inter-active speakers are the M2 and M3.

The family of inter-active speakers is dedicated to the idea of optimum dispersion for good stereo imaging using purpose-designed amplification for each drive unit, in conjunction with electronic crossover (dividing) networks with precisely tailored characteristics, said the hi-fi experts at Audio 2000. A Meridian 101 preamplifier is planned to meet the demands of the new speaker system.

The Boothroyd-Stuart team, who developed the Meridian equipment,

were presented with a British Design Council Award. The award was for design excellence of Meridian high fidelity products and was presented by HRH The Duke of Edinburgh.

The award winning system was made up of the modular components from which a range of hi-fi systems are assembled providing output power from 35 W/channel to 100 W.

Meridian products can be obtained from Audio 2000, P.O. Box 107, Brookvale NSW. (02)939-2159.



# A revolutionary way to grow younger.

Let's face it, every car interior gets old. But it needn't show. The Kitten System has created Revive All, the facelift that comes in a bottle.

Revive All will dramatically improve the appearance and feel of vinyl or leather upholstery, the dashboard, inside doors, roof linings, tyres, rubber bumper strips and vinyl tops.

Now this isn't just an extravagant claim. Revive All penetrates surfaces with a special silicone film to restore original beauty.

And if you use it regularly, Revive All will preserve against cracking and decay caused by natural elements.

If you have an interior that needs cleaning, we recommend Kitten Interior Cleaner or Kitten Upholstery Cleaner before using Revive All.

Otherwise, for your car's good health, use Revive All regularly and help your car grow young.



## THE KITTEN SYSTEM.

**THE CREAM OF CAR CARE.**

## MICHELL ENGINEERING

**"OUT OF THE DARKNESS..."**



Experience the beginning of a new era of sound with **MICHELL ENGINEERING'S** latest masterpiece – the **GYRODEC**.

With its ultimate in precision British engineering and logical design Michell's **GYRODEC** sets the highest ever standards in disc sound quality, far surpassing existing performance levels to give breathtakingly clear sound, fresh as the dawn.

Never before has the space, scale and power of musical performances been so thrillingly

brought to life. **GYRODEC** moves closer to the ideals of mechanical neutrality and environmental isolation than ever before, requires no critical fine tuning or setting up to yield its uniquely accurate sound, and has provision for mounting a second pickup arm.

The arm mounting system gives correct mechanical and geometrical relationships between the **GYRODEC** and the best of current pickup arms including **SYRINX**, **ALPHASON** and others.

Experience Michell's **GYRODEC** at your specialist retailer or for further enlightenment about its startling superiority, complete coupon and send to:

**AUDIO 2000, P.O. Box 107, Brookvale NSW 2100**  
**Ph. 939 2159 Telex 70535**

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## SYSTEMDEK II

an enviable standard for its price, representing fine engineering & acoustic value for money.

**\$399**



Arm & cartridge not included  
Record clamp optional extra

Incorporating many of the design and performance features of our most advanced unit, the Systemdek III, this completely new concept in a budget turntable provides the opportunity for audiophiles to experience the immense benefits that an advanced signal source is able to achieve.

An improved suspension system isolates the specially designed glass platter from the base and its surroundings to provide a level of performance unheard of in this price bracket. And compared with its competitors, the Systemdek II offers a two speed option, simpler alignment procedures, levelling feet and easier arm fitting.

If you are serious about your hi-fi and interested in 'acoustic value for money', then the Systemdek II is worthy of your attention.

See your Systemdek dealer today and discover the true meaning of value for money . . . Systemdek II.

For further information contact  
Convoy Sydney, 400 Botany Rd., Alexandria 2015. Telephone (02) 698 7300

# LIFESTYLE NEWS

## Enjoy hi-fi while you drive

Concord's latest model in Australia, the HPL-130, an AM/FM radio cassette unit, is a no-compromise 'top-of-the-line' enthusiast-oriented product, say Concord.

Featuring quartz digital synthesised AM/FM tuning and Concord's exclusive signal processor circuitry, the HPL-130 has a four gang front end and 25 watts per channel amplifier section.

The front end offers ten station memory presets, local and distance switching, FM muting and hi-blend sensitivity control and digital frequency display.

The cassette deck has metal and

standard tape compatibility, a Sen Alloy tape head, Dolby noise reduction, power off tape eject, automatic repeat play function, extremely low wow and flutter and a precision speed control.

For further information contact Mr. Martin McMurray, General Manager Sonic International, 4 Clarendon St, Artarmon NSW 2064. (02)439-8900.

## Digital discs first in Japan

Japanese audio makers, Pioneer and Trio-Kenwood, have said that they will be marketing digital audio disc players in Japan by the end of this year. Sony and eight Sony Philips licensees in Japan also said they will bring their players to the market this year.

Pioneer and Trio-Kenwood make a digital audio disc player under license from Sony and N.V. Philips, which jointly developed the laser-style system.

Software is supplied by a Sony-CBS joint venture, Polygram, Denon and Toshiba-EMI.

## Tape motion analyser

Bell and Howell's tape motion analyser, TMA 3000, is a microprocessor controlled test instrument. It is IRIG compatible to 240 IPS for measurement of tape recorder tape dynamics including flutter, TBE and skew.

There are nine reference frequencies and interface options available. For further information

Pioneer has set a dollar equivalent retail tag of US\$761 and Trio-Kenwood, which developed its player jointly with Toshiba, has set a price of US\$923. Its model can program up to 99 selections compared with the Pioneer model's 16 selection capability.

contact Fred Liackman at Bell and Howell on (02)660-5366.

## Electronic hand clapping

A British patent application has been filed for a circuit that synthesises the sound of human hand clapping. It enables a pop group to play musical instruments live on stage, while backed with the sound of rhythmic hand clapping.

According to the inventor, David Simmons, there is an easy way to imitate the sound of several people clapping in unison. He says it is only necessary to generate a background crashing noise overlaid with the sound of one or two short individual clapping sounds.

The background crashing is produced by amplifying an electronic noise of random frequency and random amplitude. By a happy coincidence, many electrical components, such as resistors and transistors, produce just this kind of noise at low levels. So all that is necessary is to boost the noise in a powerful amplifier.

The single hand clap is synthesised by generating an audio signal which sweeps down in pitch.

A tone of 1.6 kHz is rapidly switched on and then allowed to fall to around 200 Hz in 7 ms. When a train of these sweep pulses is superimposed on background crashing, the combined sound is like a hand clapping in time with the music.

The rhythmic pulses are generated by a timing circuit, but the inventor suggests that this should not be too accurate or the sound would be unnatural! Very few people clap in strict tempo. It is also possible to trigger the claps by an audio sensor that responds to sudden sounds. So if the sensor is placed alongside the drummer's kit, the electronic claps will follow the rhythmic beat of the drums—a great morale-booster when playing in empty halls. □



## Nakamichi ZX-7 cassette deck

The ZX-7 is a cassette deck designed for the serious tape recordist, offering extensive manual calibration control for achieving optimum performance with any tape.

Record head azimuth alignment control, record/playback level and bias can be manually adjusted to optimum levels for the characteristics of any tape. Calibration is carried out in a three step process, azimuth, level then bias. Through careful adjustment a frequency response of  $20.21 \text{ kHz} \pm 3 \text{ dB}$  (ZX/ metal tape) can be achieved.

The ZX-7 employs Nakamichi's asymmetrical, diffused resonance, dual capstan transport. However, instead of a CMOS logic circuit, transport control is now handled by an NMOS 4-bit microprocessor which improves the overall performance of the system.

Once recording level and left/right channel balance have been set, automatic fade-in and fade-out of the recording level is possible with the

master fader control. It allows either a two second or six second fade, 'up' or 'down'.

The same Dolby B-C noise reduction processor ICs are used in all Nakamichi decks. As the S/N ratio of the Dolby processor IC is 74 dB (Dolby C encoding mode), the total dynamic range of the Dolby circuit can reach 100 dB.

The ZX-7 record head, playback head and erase head are arranged in a completely discrete configuration. Also incorporated is a system for precise alignment of the record head azimuth.

Other features include a remote control unit RM-200 (optional), MPX filter switch, dc power output for blackbox series and record/playback timer operation.

## Sanyo personal audio system

Sanyo has now introduced its M-G30 personal audio system which has stereo listening from radio or cassette through lightweight headphones.

It has an AM/FM stereo tuner with LED stereo indicator. The M-G30 operates on batteries or ac with an optional adaptor. The cassette takes both metal and normal tapes with auto stop at the end of the tape.

This 'personal audio system' has all the features of a large cassette with the added bonus that you can take the M-G30 anywhere as the accessories include shoulder strap, carrying case and stereo headphones for private listening.

The Sanyo M-G30 is available at a suggested retail price of \$111.00.

For further information contact Mr. W. Fabiszewski, Sanyo Australia Pty Ltd, 225 Miller Street, North Sydney NSW 2060. (02) 436-1122.



# Review of the Quad electrostatic loudspeakers, model ESL-63

Once upon a time, Peter Walker of Quad Electroacoustics, made an electrostatic loudspeaker. The fame of this speaker spread throughout the lands. This product was held in such reverence it was the standard by which all others were compared. Two score and some years later a new standard was established... by others. But, knowing such a day would come, Peter Walker had spent nigh on two score years developing a better product. But will it establish an even 'newer' standard? Perhaps...

THIS REVIEW theoretically started at a party in 1979 which the Australian Importer for Quad loudspeakers arranged to welcome Ross Walker, the son of the Managing Director of Quad Electroacoustics Ltd, during a brief visit to Australia.

I sat opposite him at the table and asked the ubiquitous question "when are you going to release the new Quad loudspeakers?" and received the nonchalant answer, "...in a little while!", which told me that they were seriously working on the project. His next response was that they would not release a new loudspeaker unless it was a significant improvement on the (then) current Quad electrostatic loudspeaker. Knowing the calibre of the company and its products, I accepted this statement as a matter of fact and the discussion moved on to more mundane matters.

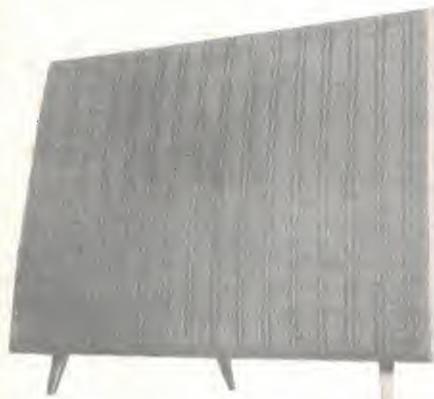
It was only a few weeks later that Peter Walker, Managing Director of Quad Electroacoustics Ltd, demonstrated his new prototype ESL-63 to a packed meeting of the Audio Engineering Society in London. The news of that momentous gathering was not lost on the rest of the technical world and the technical journals literally 'hummed' for almost a year with all sorts of possible and tentative guesses as to when the production version would be released.

It took until June 1981 to solve the not inconsiderable manufacturing problems and the speaker was released with a blaze of publicity. We had to wait a further 14 months to get hold of a privately owned pair of the new speakers.

You might well ask what is so special about Quad electrostatic speakers. The answer, to me, is quite simple as I already own a pair of the original Quad loudspeakers which are used in conjunction with an Audio-Pro B2-50 sub-woofer. The Quad's performance is still regarded as outstanding some 26 years after their original release. But, because of their size and shape, I have been hard pressed to find the right location in my living room to place these speakers and the addition of the Audio-Pro sub-woofer has only compounded the problem. The sub-woofer proved to be an essential addition as the lower effective frequency for the Quads was a mere 60-70 hertz, which is just not good enough for the high quality records and tapes now available. Even with the sub-woofer added to the system the major limitation still becomes the maximum undistorted output level from the Quads which at one metre tends to be between 90-95 decibels, depending on the weather. No, it is not that I may be under the weather, but rather that under the influence of high humidity there is always a likelihood of ionisation particularly under high drive conditions when the speakers have to produce peak signal levels. Fortunately the original Quads used a selenium rectifier stack for the high voltage supply and this tended to be relatively immune to such problems (except on the occasion when the speakers were left running and one rectifier stack failed completely. Both the smell and the cost of repair proved to be unacceptable).

The Editor and I knew that the magazine's readers would be just as

interested as we were to see how well the new Quads performed. Equally important, Peter Walker has been working on the design of these speakers since 1963 and a 19-year gestation period is a remarkably long one for any piece of electro-acoustic equipment.



The original Quad electrostatic speaker.

## Dramatic change

The ESL-63 loudspeakers present a dramatic change in visual impact when compared with the original Quad electrostatics. Whilst the original Quads are ungainly, and many would say ugly, the ESL-63s are visually attractive and not out of keeping with either a modern architectural internal decor or even a room of antique furniture. They are, I believe, as attractive as the old Quads were unattractive. The reasons for this are not hard to see.

Firstly, the older Quads featured either a black or bronze expanded

aluminium protection grill overlying a swept-back rectangular shaped panel with wooden sides and with two small wooden legs at the front and one at the rear.

The new Quads, by contrast, feature an attractive wooden top and bottom to the main cabinet structure. The lower one rests on top of a molded black plastic pedestal which extends beyond the back of the unit. This pedestal incorporates the power supply rectifiers, delay lines and protection circuits, which form an integral part of each speaker unit. The face of the unit is covered by a seamless stocking of open weave brown terylene cloth. This provides necessary and important protection for the lightly framed electrostatic elements located behind. These elements have a number of important differences when compared with the original Quads. Firstly as the illustration shows, the design incorporates a series of concentric elements with annular electrodes, to which the signal components are individually fed by means of sequential delay lines. This is done in order to reproduce a sound pressure response which is theoretically (but not practically) an exact replica of the sound signal that would be produced by an ideal point source located approximately 300 mm behind the plane of the diaphragm.

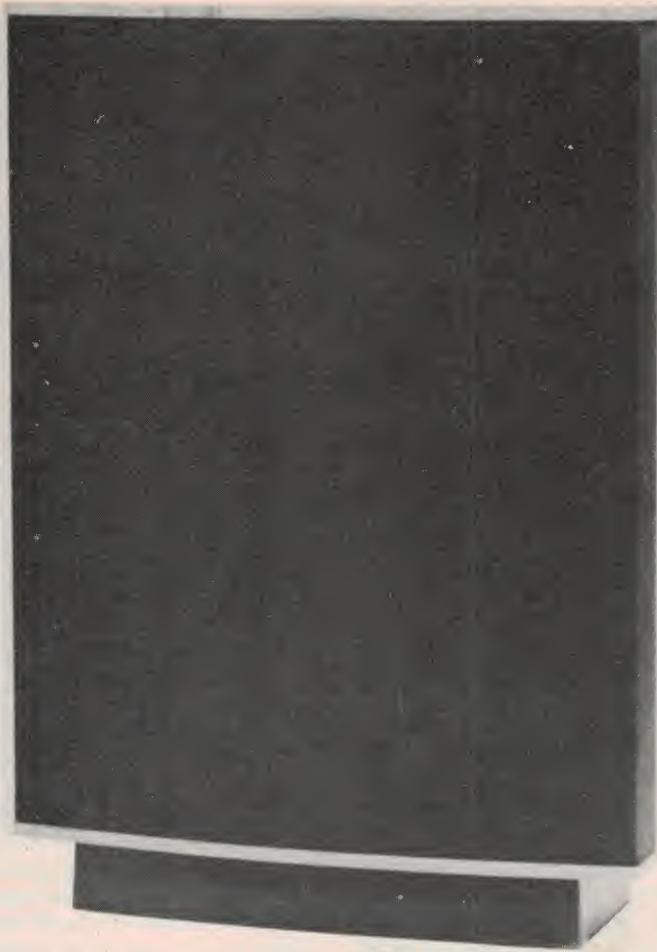
The aim of such a configuration is to produce an homogeneous, or equivalent, point sound source with a linear phase response and a frequency response that is as smooth as possible both on- and off-axis.

Obviously such a structure behaves like a true dipole and Quad have introduced the acronym FRED (full range electrostatic doublet) to describe the system. Such a system has a number of positive and unquestioned benefits. Firstly, that it offers benefits in terms of the speaker placement within a typical living room. Secondly, the stereo imaging effect is substantially better than that provided by most conventional loudspeakers and thirdly, if the frequency response is right it should be able to more closely reproduce the original sound, with a subjective realism superior to that achieved by more conventional loudspeakers with which you and I are now very familiar.

### To the test!

Obviously, I was itching to get the speakers into our anechoic room to see how they would perform, for after all the good things written by overseas (subjective) reviewers, it was time to put the speakers fully to the test.

The first set of parameters that we evaluated was the measurement of the frequency response both on- and off-axis. The results were, as you can see from



The new Quad Model ESL-63 electrostatic loudspeaker — more attractive than its predecessor.

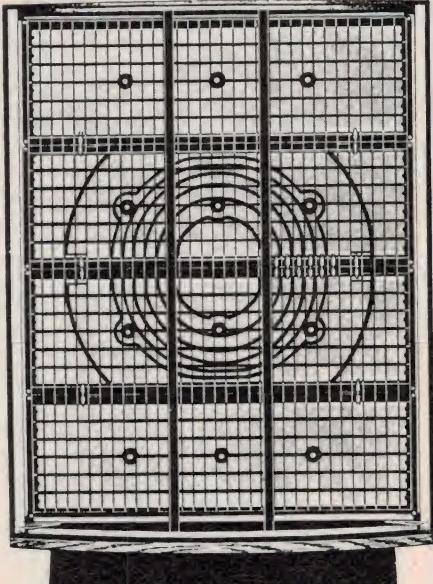
the graphs, particularly commendable with a flatter frequency response over the range 40 Hz to 8 kHz than I would have expected. What was particularly noticeable was the sharpness of the resonant response at 45 Hz (where the damping is obviously too low) and the degree of nonuniformity which is so noticeable in the range 5 kHz to 20 kHz. The off-axis response however, is still excellent, only dropping by approximately 2 dB in the midband, by 5 dB at 8 kHz, by 6 dB at 13 kHz and 10 dB at 17 kHz. I wondered about the sharpness of the low frequency resonance, and the bottom end would obviously behave somewhat differently when presented with a reflective floor surface and a reflective rear wall surface, but more about that later.

Our next investigations were the assessment of the phase response, the results of which took me by surprise. Our first response displayed a series of cyclical variations that were periodic with increasing frequency and which did not go away even after we had correctly aligned the microphone with the true centre axis of the loudspeaker in the anechoic room.

It took me some time to realise that if one is 'off-axis' or the delay line tappings

are not perfect, then there must be a series of competing signal components from each of the annular sections of the radiating diaphragm array which can produce small interference patterns. This is totally inaudible, primarily of academic interest and most upsetting

Inside the Quad ESL-63 showing the concentric annular electrodes.

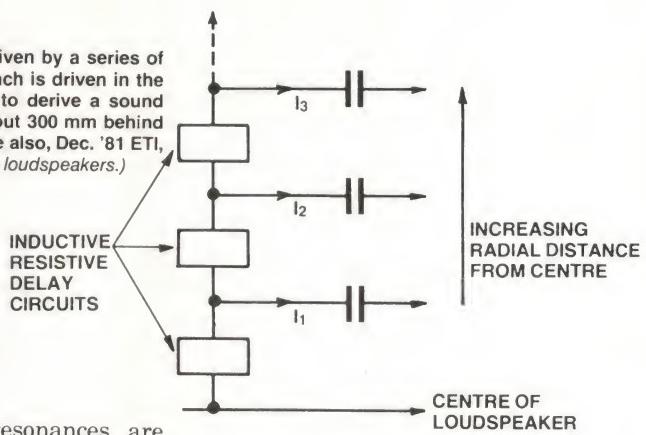


for reviewers who wonder where they might have gone wrong! The phase response of the Quad is nonetheless excellent, varying by less than  $\pm 90^\circ$  from 20 Hz to 20 kHz. That response has only been bettered by very few other speakers in my experience of speaker testing.

The impedance curve is interesting as it features a modest rise from a minimum of 4 ohms at 10 Hz up to a 24 ohm peak at 100 Hz. This drops away again to 6 ohms at 10 kHz with a rise again to 15 ohms at 20 kHz. This impedance curve is slightly load sensitive, but irrespective of the load would not cause problems for any normal amplifier. The manufacturers do however warn that amplifiers without internal short circuit protection should not be used to drive this speaker. The reason for this, as we subsequently discovered, is that when overdriven, the speaker's protection circuit applies a voltage limiter, in the form of a thyristor, which is connected across the input terminals and which only resets when the dangerous signal is removed. (Sounds like a job for the ETI-494 speaker protector, published last month! — Ed.)

The most interesting tests of the Quad ESL-63 were firstly the conventional tone burst tests, performed at the standard frequencies and also at 40 Hz, and secondly, the decay response spectra. The latter is one of the most revealing tests and has enabled us to correlate some aspects of the objective response with the subjective response. The tone burst tests revealed that the ESL-63 has a relatively sharp Q in its response at 40 Hz. The decay response test revealed significant decay resonances at 3.5 kHz, 6 kHz, 8 kHz, 13 kHz

The annular electrodes are driven by a series of delay line elements so that each is driven in the approximately correct phase to derive a sound source that appears to be about 300 mm behind the plane of the elements. (See also, Dec. '81 ETI, Inside Quad's latest electrostatic loudspeakers.)



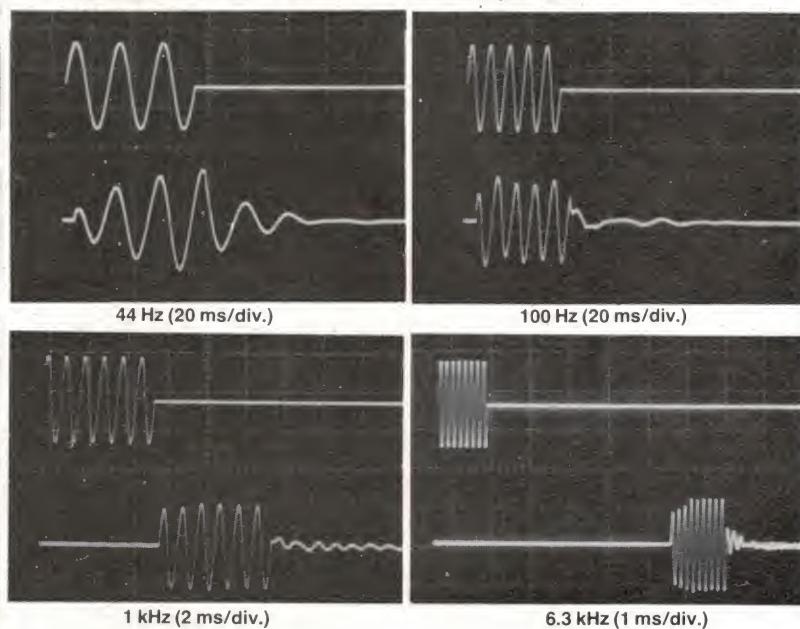
and 17 kHz. Other resonances are observable in the region above 18 kHz but are generally of little concern.

The smooth response below 3.5 kHz subsequently proved to be important as I had expected to find significant mid-band resonances. The original Quad electrostatic speakers and, albeit, most electrostatic speakers that I have so far examined, have exhibited such resonances. They provide some of the 'characteristic sound' or colouration that electrostatic speakers possess and which I feel is often mistaken for an attribute even when it is not.

The last of the objective tests that we performed was the distortion level at 10 volts input, the value specified by the manufacturer for continuous sinewave excitation. Here we found the distortion levels much lower than those produced by the previous model Quads and generally amongst the lowest levels we have yet seen from any loudspeakers operating at comparable acoustical output. We endeavoured to perform a transient evaluation of distortion but had less success than we did utilising our conventional technique because the transient levels were lower than we could reliably measure.

Tone-burst response of Quad ESL-63 electrostatic loudspeakers.

LOUDSPEAKER DATA SHEET	
<u>MEASURED PERFORMANCE OF:</u>	
Quad Electrostatic Model ESL63	SERIAL NO.: 8552
<u>FREQUENCY RESPONSE:</u> 35Hz - 20kHz	
<u>CROSSOVER FREQUENCIES:</u>	
<u>SENSITIVITY:</u> 11.5 VRMS - 16.5 Watts (nominal into 8Ω)	
(for 90dB average at 2m)	
<u>HARMONIC DISTORTION:</u>	
(at 10V input as specified)	S.P.L. 83dB 88.5dB 89dB 100Hz 1kHz 6.3kHz
	2nd -63.7 -72.0 -72.1 dB 3rd -46.5 -77.3 -65.2 dB 4th -68.0 -78.6 -76.1 dB 5th -56.4 -77.6 -- dB THD 0.5% 0.034% 0.06%
<u>INPUT IMPEDANCE:</u>	
	100Hz 23 ohms 1kHz 8.3" 6.3kHz 5.8" L.F. Minimum at 10Hz 4.0" H.F. " " 10kHz 5.4"





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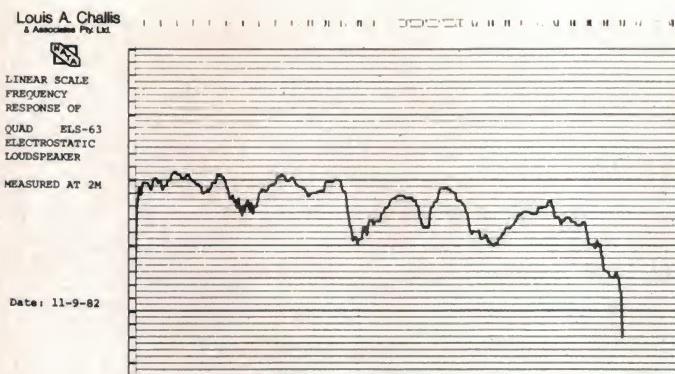
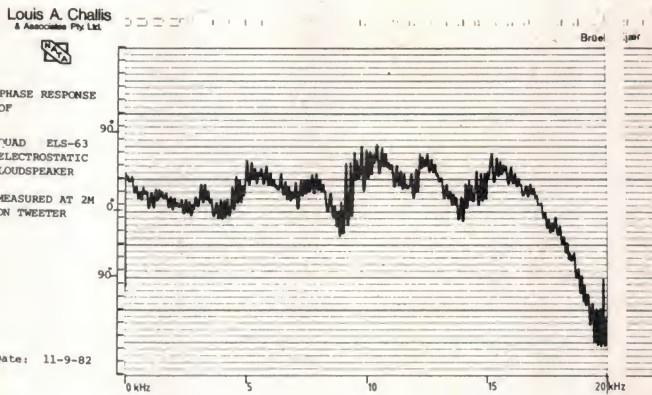
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Design and specifications subject to change without notice.



This was confirmed with the Swedish (Svenska) Hi-Fi Institute Test Record which revealed traces of mid-band colouration from the speakers which I had not previously detected in my A-B testing procedure. This was confirmed in part with white noise signals where the signal was not as 'neutral' as I would like.

*On most pre-recorded voice material the fidelity of realism of these speakers proved to be absolutely superb and this performance has not been equalled or bettered by any speaker that I have yet tested. It is clear that Peter Walker's ideas are right, even if they have not achieved true perfection.*

I continued listening to these speakers for over six hours of unquestioned pleasure and although I often find such work a chore, on this occasion I found it to be both technically and musically

rewarding. I was then convinced that the Quad ESL-63 loudspeakers are unquestionably a dramatic leap forward in speaker technology.

The concept of the concentric elements fed by delay lines is a good one, although the fully developed concept requires extremely precise matching of the component values if true perfection is to be achieved. (The units tested approach this but didn't quite achieve it.)

The achievement of a better damped decay response is another feature which if attained, will further improve these speakers. If any further improvements are to be investigated, it is in this area that the research should be directed.

These speakers are exceptional in many ways with only one of them being ingenuity and another most certainly being perseverance.

At a recommended retail price of

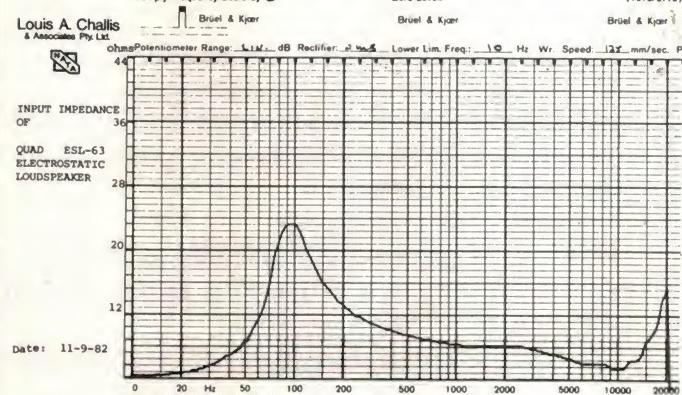
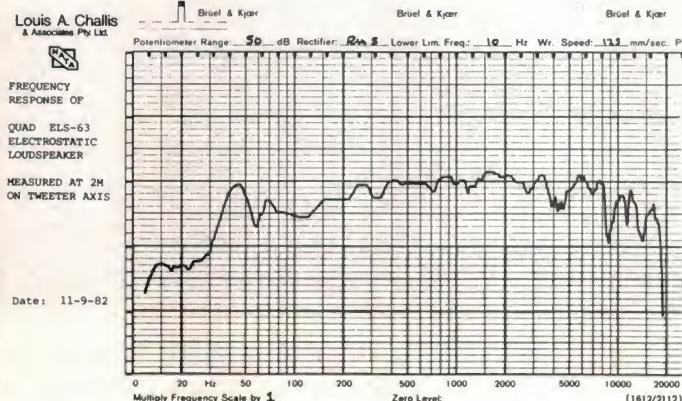
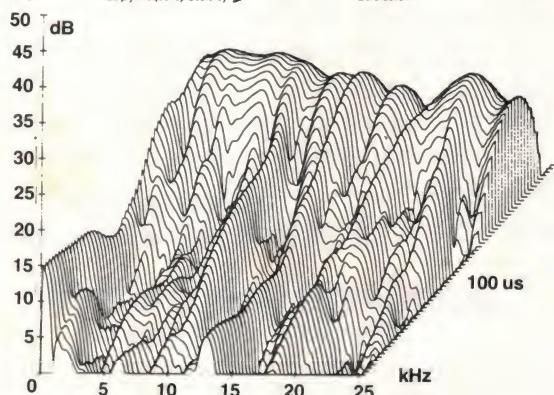
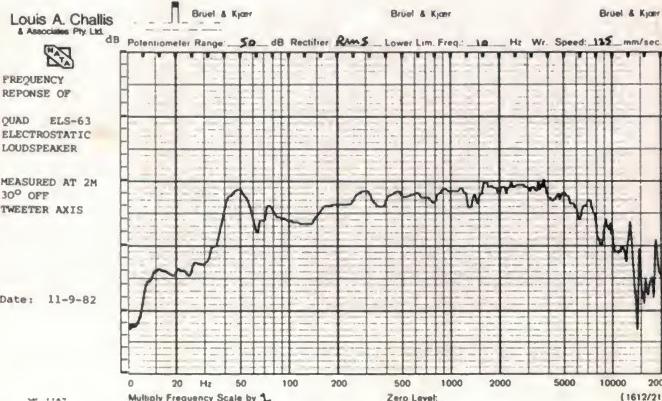
\$4800 a pair, I think there will be plenty of people who will buy them solely because of their 'price', without really appreciating their finer technical attributes.

#### QUAD ELECTROSTATIC LOUDSPEAKERS, MODEL ESL-63

Dimensions: Height: 925 mm  
Width: 660 mm  
Depth: 270 mm, including  
150 mm base

Weight: Nett: 18.7 kgs  
Price: Recommended Retail: \$4800 per pair

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didn't come from this small  
French village.



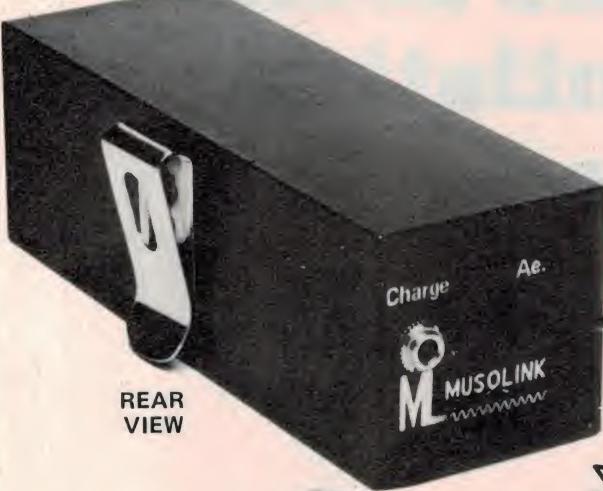
This little village in Burgundy has been making an attractive dry white wine for quite a while now. The wine has long been called after the name of the village...Chablis.

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# Audio amplifiers using nested differentiating feedback loops

## Part 2 — The basic idea

**Edward M. Cherry**

Associate Professor  
Department of Electrical Engineering  
Monash University

Here we get to see how this technique is applied to an amplifier and the effect it has on performance under differing conditions.

LAST MONTH we saw that, for a feedback amplifier to be stable, the separation between the forward-path gain and the demanded gain in graphs such as Figure 3 should not decrease towards zero at a rate exceeding 20 dB/decade. If an amplifier uses conventional resistive feedback, this stability criterion requires that the forward path must have just one dominant pole  $1/\tau_\mu$ , usually achieved in practice by suitable lag compensation. All the poles associated with transit time effects in transistors must be at substantially higher frequencies than  $1/\tau_X$ , the frequency of intersection of the curves of forward-path gain and demanded gain. Thus, available transistor types ultimately force the choice of  $1/\tau_X$ , and hence set a limit to the reduction of distortion that can be achieved by feedback because the return difference  $F(\omega)$  at angular frequency  $\omega$  in Equation 7 cannot exceed

$$F(\omega) \leq 1/\omega\tau_X. \quad (8)$$

There is, however, another solution to the stability problem. If the forward-path gain has two dominant poles, so that its gain falls at 40 dB/decade, the rate of closure between the graphs of forward-path gain and demanded gain would still be 20 dB/decade provided the demanded gain itself were to fall at

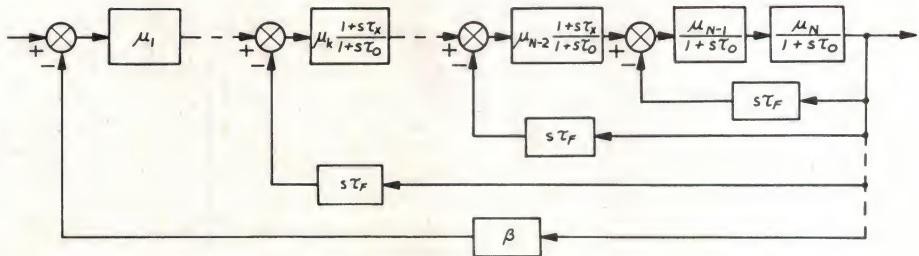


Figure 5. Block diagram of an NDFL amplifier.

20 dB/decade. In essentials, this requires that the usual frequency-independent resistive feedback factor  $\beta$  should be replaced by something having a frequency dependence of the form  $\omega\tau_F$  (remember that the demanded gain is the reciprocal of the feedback factor). Mathematicians tell us that a linearly rising frequency response corresponds to differentiation with respect to time and, in hardware terms, a capacitive feedback network will perform just this action.

Figure 5 shows the outline of an amplifier incorporating nested differentiating feedback loops.

Notice first that the forward path has been separated into a number of stages, whose mid-frequency gains are  $\mu_1$  to  $\mu_N$  respectively. The variable  $s$  is what mathematicians call complex frequency; for sinusoidal signals its magnitude is equal to the angular frequency  $\omega$  of the

sinusoid. Factors of the form  $(1 + s\tau_X)$  represent a frequency response that rises proportional to frequency above the frequency  $1/\tau_X$  — that is, they represent a zero. Similarly, factors of the form  $1/(1 + s\tau_0)$  represent a frequency response that falls inversely proportional to frequency above the frequency  $1/\tau_0$  — that is, they represent a pole. Thus, the stages in Figure 5 have special frequency responses: all stages except the first have a pole at  $1/\tau_0$ , and all except the first and last two have a zero at  $1/\tau_X$ .

Notice also that there are differentiating feedback networks, each denoted by  $s\tau_F$ , linking the output back to various points in the forward path. The resulting feedback loops are arranged one inside another, like a nest of Chinese boxes — hence the name nested differentiating feedback loops.

The amplifier is completed by an overall resistive feedback network  $\beta$ .

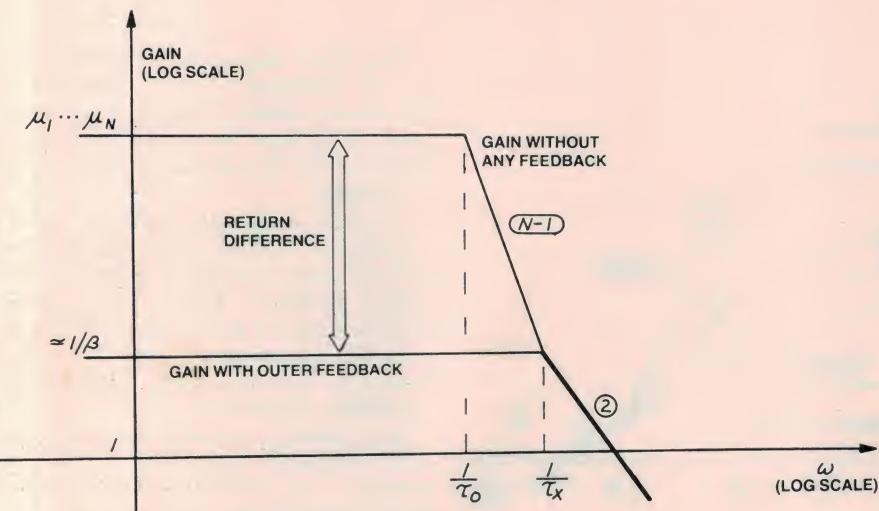


Figure 6. Logarithmic plots of gain versus frequency for Figure 5.

If we removed all the feedback from Figure 5, the forward-path gain would be shown in Figure 6: constant up to the frequency  $1/\tau_0$ , then falling at an  $(N-1)$ -pole rate ( $20(N-1)$  dB/decade) up to  $1/\tau_x$ , and finally levelling off somewhat to a two-pole rate ( $40$  dB/decade).

If we now applied just the overall resistive feedback  $\beta$ , the return difference would be as shown in Figure 6. Distortion would be reduced by a constant large amount, approximately  $\mu_1 \mu_2 \dots \mu_N \beta$ , at all frequencies up to  $1/\tau_0$ . Choosing  $1/\tau_0$  to correspond to  $20$  kHz would virtually eliminate audible-frequency distortion. *But the amplifier would be unusable because of oscillation.*

The rate of closure of the forward-path gain and demanded gain curves breaks the rule of  $20$  dB/decade. Let us see how inclusion of the nested differentiating feedback loops solves the problem.

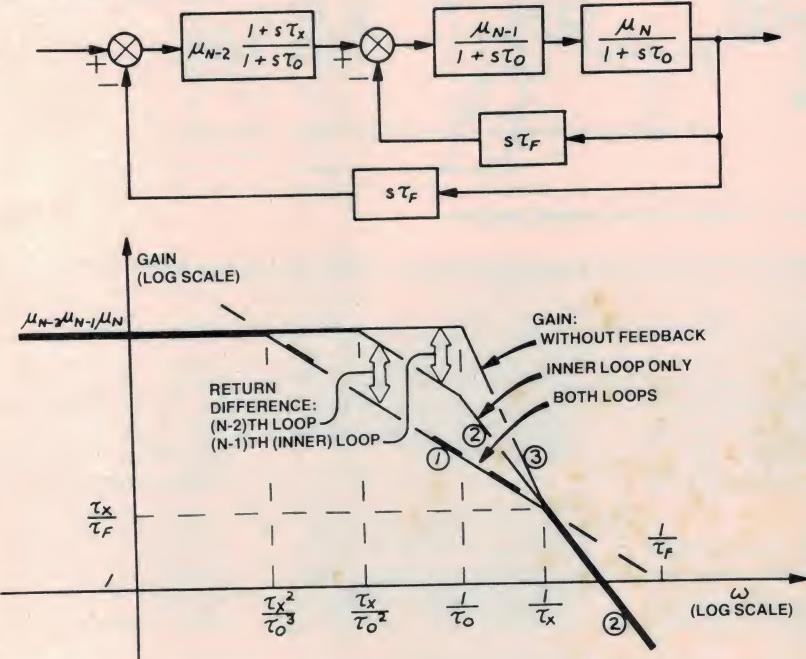


Figure 8. The (N-2)th loop of Figure 5.

Figure 7 shows just the last two stages and the inner differentiating feedback factor. This 'clump' is a feedback amplifier in its own right, and Figure 7 shows its forward-path gain (that is, the gain of the last two stages without any feedback), the demanded gain, and the resulting closed-loop gain. Although the forward-path gain falls at a two-pole rate ( $40$  dB/decade), the demanded gain falls at a one-pole rate ( $20$  dB/decade), and their rate of closure is  $20$  dB/decade. By itself, this 'clump' is stable.

Figure 8 shows what happens when we add the antepenultimate stage and another differentiating feedback factor.

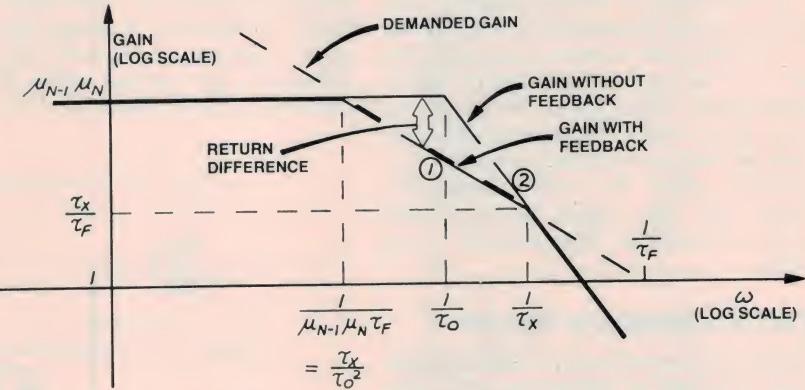
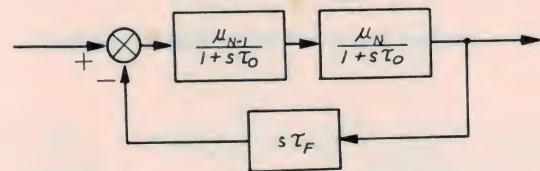


Figure 7. The inner loop of Figure 5.

Again this 'clump' can be considered as a feedback amplifier in its own right. Provided we choose

$$\mu_{N-2} = \tau_0 / \tau_x$$

the various gains line up as shown. The forward-path gain is the combined gain of stage (N-2) and stages (N-1) and N with their local feedback, and this is the middle solid curve in Figure 8. The demanded gain is the dashed curve passing through  $1/\tau_f$ . Once again the forward-path gain and demanded gain close at  $20$  dB/decade, so the stability criterion is satisfied for this larger 'clump'.

And so it goes on. We can add more stages and differentiating feedback factors, and each time the curves line up as required for stability provided we choose

$$\mu_1 \mu_{N-1} \mu_N \beta = (\tau_0 / \tau_x)^2, \quad (9)$$

$$F = \mu_1 \beta \tau_x, \quad (10)$$

$$\mu_k = \tau_0 / \tau_x \text{ for } 2 \leq k \leq N-2. \quad (11)$$

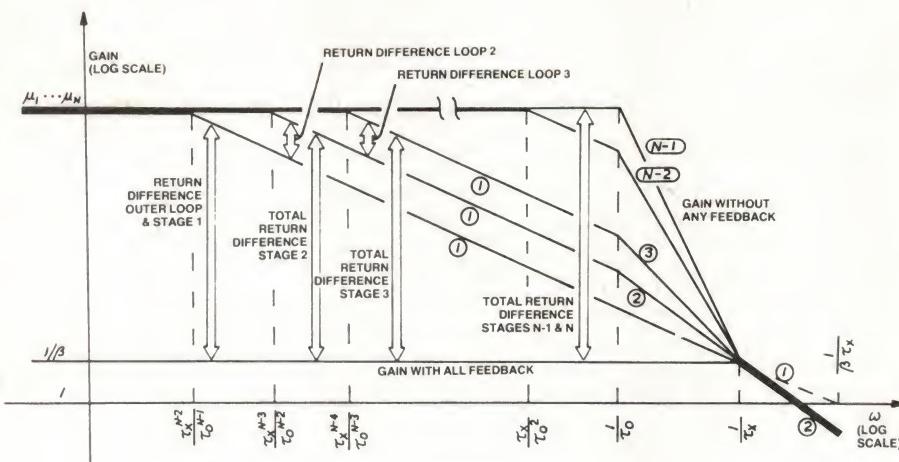


Figure 9. Complete plots of gain versus frequency for Figure 5.

Figure 9 shows the gain curves for the complete amplifier.

In designing an NDFL amplifier, the starting point is to choose the frequency  $1/\tau_X$  so that the various transistor poles are sure to lie at substantially higher frequencies. Next choose the frequency  $1/\tau_0$  up to which the return difference should remain constant; 20 kHz is a suitable value for audio amplifiers. After this, the circuit more or less designs itself via Equations 9 — 11 above.

### Outline practical circuit

Figure 10 shows how an amplifier of the basic topology of Figure 2 can be modified to include two NDFLs. Interested readers should refer to references 14 — 16 for more details.

Notice first that the lag compensating capacitor, C, in the penultimate stage of Figure 2 has been removed in Figure 10. In its place are two capacitors (C) linking the output back to various points in the forward path. These capacitors are the feedback networks of the nested differentiating feedback loops.

The output stage has been changed to include a modified form of Thiele's load-stabilising network. Some form of LRC filter is required to locate one of the poles correctly, and with the circuit shown we get double value from the components (see references 17, 18).

The input stage itself is unchanged, but an inexpensive small capacitor in the overall feedback network  $\beta$  can be used to correct the group delay and improve the reproduction of transient waveforms.

Another essential addition is an amplifying stage between the two nested differentiating feedback factors. This rather peculiar circuit (which dates back to Rush in 1964) seems largely to have been forgotten. It uses one n-p-n transistor and one p-n-p to provide a well-defined gain (19).

As already suggested, once the demanded gain  $1/\beta$  and the critical frequency  $1/\tau_X$  are chosen, the circuit almost designs itself. The equations are:

$$\frac{R_{F1}}{R_{F1} + R_{F2}} = \beta, \quad (12)$$

$$RC = \beta\tau_X, \quad (13)$$

$$RYC_Y = \tau_X, \quad (14)$$

$$\tau_L = (\sqrt{3} - 1)\tau_X. \quad (15)$$

All stage gains and poles and zeros automatically look after themselves.

*continued on page 129 ▶*

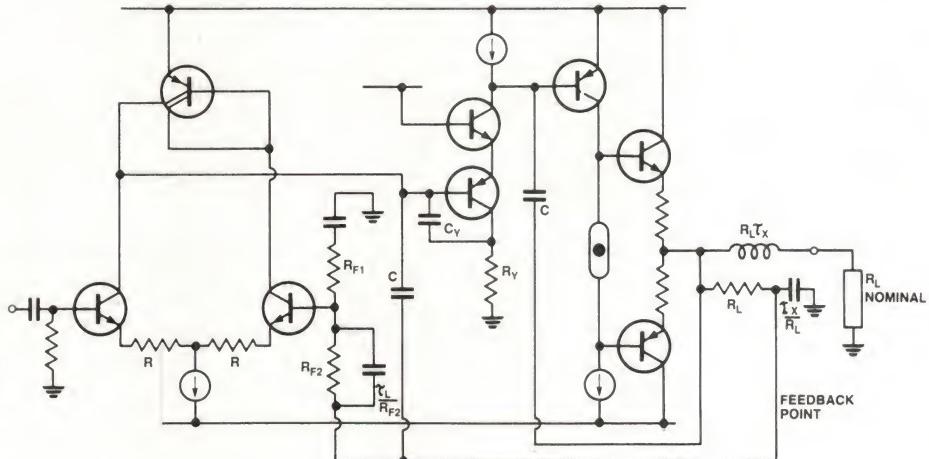


Figure 10. Outline circuit for an NDFL amplifier.

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14. E.M. Cherry, *A high-quality audio power amplifier*, Proc. IREE (Aust), vol 39, pp 1-8, Jan/Feb 1978.
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# BLACK POWER



Pioneer Black Avante Systems give you the very latest in sound technology. Featured here is the G9 system - SA 930 amplifier with power output of 70 watts RMS and auto input selector, plus a TX 930 tuner with 8 FM/AM pre-set station selectors, auto band search and LED frequency indicator.

A PL 930 direct drive turntable features an exclusive quartz lock indicator to give you perfect sound reproduction at all times.

The CT 930 cassette deck has 3 motors that are computer co-ordinated for superb musical accuracy. It also features auto reverse, music search and Dolby® B&C noise reduction circuitry. A pair of Pioneer 3-way speakers with maximum output of 70 watts RMS completes the system. It all adds up to maximum sound performance - that's Pioneer Black Avante power.

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Systems and product specifications subject to change without notice.  
\*Dolby is the registered trademark of Dolby Laboratories.

"Timed to perfection,  
The Black Douglas is matured  
in oak for at least 8 years.

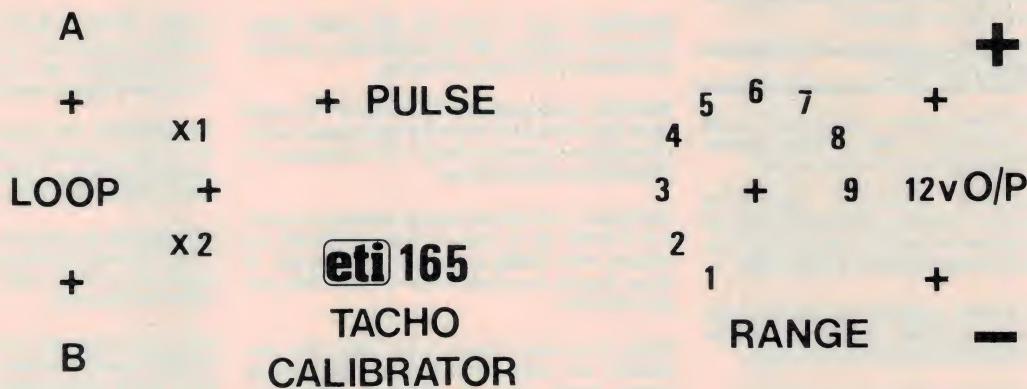
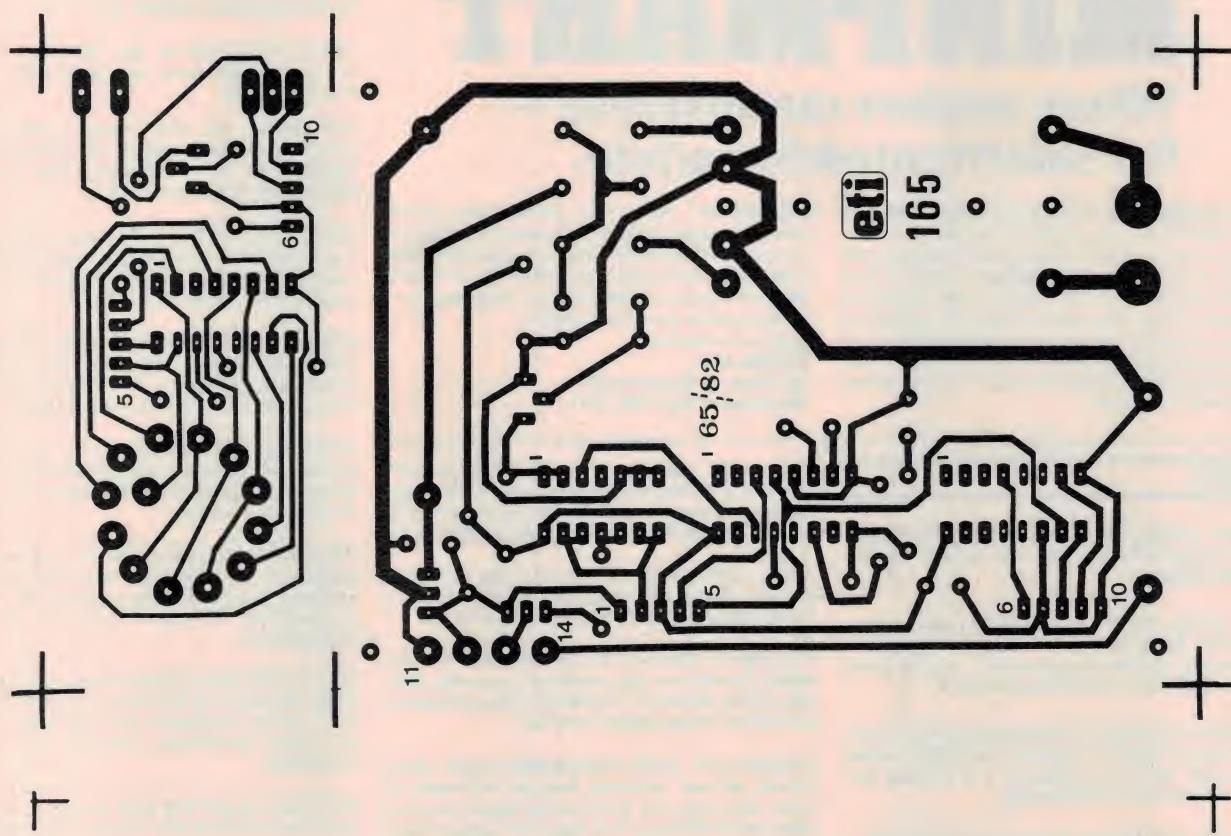
It's a smoother, mellower,  
far superior whisky.

## The Black Douglas.

A name honoured in Scotland  
for centuries . . . and still making history."

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**BLACK DOUGLAS**  
DE LUXE  
100% SCOTCH  
WHISKY  
750ml  
IMPORTED BY CONNELL & CO. LTD.  
8 YEARS OLD

CD9101 AB193982



#### Using ETI PCB Artwork

This method can be used to make negatives of ETI artwork from October 1977 on, provided the reverse of the page is printed in blue. The film used is Scotchcal 8007, which is UV sensitive and can be used under normal subdued light.

Cut a piece of film a little larger than the pc board and expose it to UV light through the magazine page. The non-emulsion side should be in contact with the page. This surface can be detected by picking the film up by one corner — it will curl towards the emulsion side. Exposures of about 20 minutes are normally necessary.

The film can now be developed by placing it emulsion side up on a table, pouring some Scotchcal 8500 developer on the surface and rubbing it with a clean tissue.

Further information on Scotchcal and pcb manufacture can be found in the September and December 1977 issues of ETI.

Please note that occasionally lack of space may prohibit the printing of blue type behind all pcbs. In this case the reader must resort to more conventional photographic techniques for pcb manufacture.

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CURTIS SYNTH. ICs: 3340(VCO), \$20. 3320(VCF), \$16. 3310(ADSR), \$16. 135 Rae St, Nth Fitzroy. (03)481-8995.

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FOR SALE: Philips ETI 4000 loudspeakers, professionally finished in black vinyl. Never used. Must sell. \$499. D. Matthews, 173 Duffield Rd, Margate Qld 4019. (07)284-6085.

B&W-D14 SPEAKERS. Purchased late last year, very little use, near new. Great value at \$650 ono. Phone (062)54-6315 ah. Canberra.

### COMMUNICATIONS

COMMUNICATIONS receiver: Drake SSR-1 triple conversion 0.5-30 MHz. Mint condition, service manual, \$190. Phone Rick (03)836-8170 ah.

COMMUNICATIONS RECEIVER. LAFAYETTE HA-600A 150 kHz — 30 MHz, 5 band transistorised with matching speaker. Both in immaculate condition. \$150 ono. Phone Gunther (045)77-3216.

FOR SALE: YAESU amateur transceiver model FT200 and power supply. Excellent condition. \$250. Emu Plains NSW. Phone (047)35-1258.

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### MISCELLANEOUS

SELL: HP41-CV. The ultimate in Alphanumeric programmable calculators. Perfect condition, complete with manuals, case etc. \$370. Peter Cooper, 7 Olinda Rd, Windsor Gardens SA 5087. (08)261-5586.

HEWLETT PACKARD 1741A 100 MHz storage oscilloscope. Current model. New price over \$7000, asking \$4000. Excellent condition with 2x 10:1 and 1x 1:1 probes, all accessories and handbook. This is the super CRO auto store, variable persistence, delay and three trace (trigger) viewing capability. Phone (07)391-2796.

SELL: 2½" oscilloscope, as new condition. Res. offers. (02)637-4741.

NEW SORCERER 32K MKII, never used. Warranty, \$1095. Sorcerer, dual stringy floppies, DEVpac, word processor, extra monitor, 80 programs. Cost \$3000, sell \$1600. (02)449-3647.

DF681 S100 PCG for sale. \$120 ono. Write to K. Goiser, 49 Lord St, Sandy Bay, Hobart Tasmania 7005.

SORCERER: 32K plus Devpac, Hi-Res monitor (not TV), manuals and lots of software, \$1000. Godbout XX 32K S100 static RAM card, \$250. Phone Terry (02)682-4649 ah.

SELL: DGZ80, S100 CPU, DG640 VDU, DGOS Level BASIC II in ROM, 16K RAM, motherboard, card frame, power supply, keyboard, digitalker plus software. \$950. (03)370-5861.

URGENT: SYM-1, BASIC, 4K RAM, keyboard and case, DG640VDU, \$400 ono. Will separate if absolutely necessary. Clive Conway, 80 Third Ave, Joslin SA 5070. Phone (08)42-3995 ah.

FOR SALE: OSI Superboard 11, 13K RAM, lots of extras and software, full documentation. David Doyle, 1 Knapsack St, Glenbrook NSW 2773. Phone (047)39-5019.

TRS-80 OWNERS: Add 16K extra memory inside keyboard for \$20. No technical knowledge required. Complete instructions \$6. G. Wain, 3 Malakoff St, Nth Caulfield Vic. 3161. (03)509-6703.

SELL: S-100 frame, motherboard, 12 sockets and power supply \$150. Boards: 280 CPU \$80. 8K RAM \$120. ASCII keyboard \$70. Cassette I/F \$40. All offers considered. Jennifer Hudson (002) 30-6338 ah.

FOR SALE: 2 MPI B52 disk drives, power supply and case, all \$800 ono. Phone John (02)36-6170 ah.

SYM-1: SWAP 8K BASIC on EPROMS for RAE-1, resident assembler editor on tape with full documentation. M. Cvetanovski, 10 Caroona Close, Adamstown Heights NSW 2289.

DREAM 6800: 16K Dreamsoft board, synthesiser, 20 mA loop, joystick, video/VHF outputs, 20 cassettes of software, 'Dreamer' all issues, Horwood case, \$220. (054)42-4756.

SOFTWARE to swap for System-80 and TRS-80. Please forward SSAE plus listing and I will do the same. Mr. A. Tito, 103 Lauren St, Urangan Qld 4658. (071)28-9527.

SELL S100 boards. 16K static RAM, \$140. 16K EPROM board complete with microworld BASIC, \$140. Fully documented. Guaranteed. C. Franks, P.O. Box 4345, Darwin NT 5794. (089)81-2541.

SHARP POCKET COMPUTER PC1211 and printer/cassette interface plus manual/programs, \$190 ono. John, 15 Robinson St, O'Connor ACT 2601. (062)72-3711.

FOR SALE: Micro-Ace computer with 2K. Complete with leads, power supply, TV adaptor and manual. Sell for \$150. Phone (075)32-5098. Gold Coast.

MICRO-ACE 4K ROM, 16K RAM, leads, adaptor, manual and programs book. \$150. Phone (02)639-3115 ah.

WANTED: Any hardware information about WANG 2200B computer and peripherals. Phil Sutherland VK6ZPS, P.O. Box 177, Nedlands WA 6009. Phone (09)386-4859 ah.

FOR SALE: ETI-660 colour computer in metal case with 3K RAM and some programs. Also 16K RAM, 4K + 8K ROMs to suit ZX80 computer with manuals and other books. No reasonable offers refused. (03)762-3058.

### COMPUTERS

SEMCON COMPONENTS, Exorcisor buss: 16 slot card cage fully socketed, \$175. 32K static RAM card, \$350. Blank D/S THP development board, \$25. Phone Ross (09)447-7248.

WANTED: Copy "Pet Revealed". Will pay \$20. Other CBM or Pet books wanted. Dr. E. Plunkett, Hill St, Eugowra NSW. Phone (068)59-2472.

APPLE 11 plus 64K RAM, sell \$1000. Steven, 1/380 Brunswick Rd, Brunswick Vic. 3055.

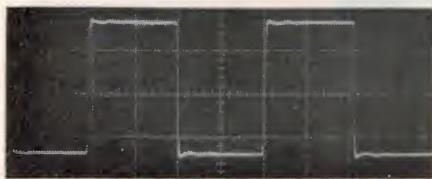
ZX-81: Tons of books and tapes. As new. Offers. Australian customers only. Padded die-cast box. Applecross WA. (09)364-7986.

# ...nested differentiating feedback loops

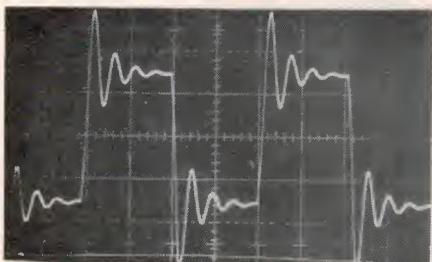
Figure 11(a) shows the 5 kHz square-wave response of Figure 10 as built from:

5%-tolerance resistors,  
20%-tolerance capacitors,  
unselected production transistors.  
Evidently the circuit is 'designable'; Equations 12 — 15 really do predict component values for good transient response.

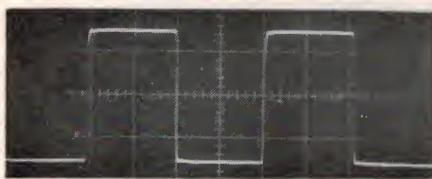
A nice feature of the modified Thiele circuit in Figure 10 is that, when the load is made capacitive (a well-known source of high-frequency oscillation in amplifiers), the voltage waveform at the FEEDBACK POINT is the waveform the amplifier would have delivered into its nominal resistance load. Figures 11(b) and (c) illustrate this; the violent ringing in Figure 11(b) is simply an LC resonance between the filter inductor and the load capacitance, and is in no way indicative of approaching instability.



(a) 8 ohm resistance load.



(b) 8 ohm and 2 uF parallel load



(c) waveform at feedback point for (b)

Figure 11. 5 kHz square-wave response of Figure 10.

Figure 12 shows details of the 1 kHz sinusoidal response under overdrive conditions. Note the quick, clean recovery.

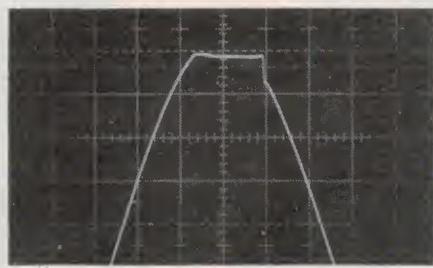


Figure 12. Detail of output waveform from Figure 10 under overdrive.

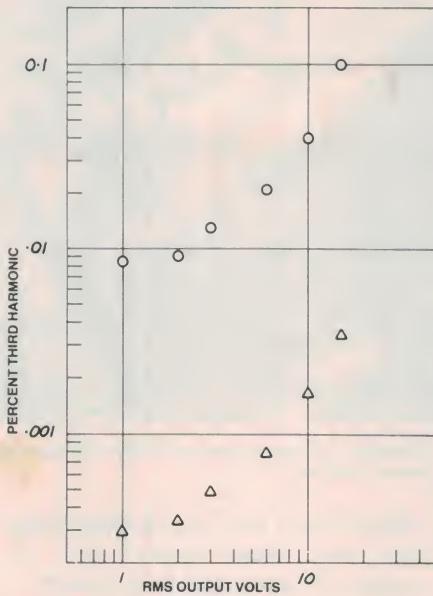
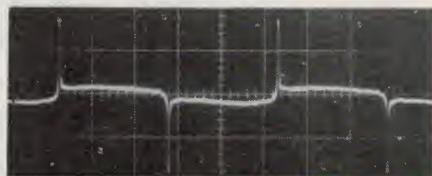


Figure 13. 1 kHz third harmonic distortion  
○ — Figure 2 (conventional amplifier);  
△ — Figure 10 (NDFL amplifier)

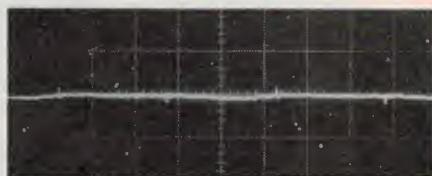
An amplifier has been built in which the circuit can be switched from Figure 2 to Figure 10, to illustrate the improvement in performance of adding two NDFLs. Figure 13 compares the measured third-harmonic distortions of 1 kHz. Notice how the distortion of Figure 10 drops away to below three parts per million at small signal amplitudes. Such behaviour is more typical of class-A amplifiers than class-B amplifiers, and may account for the clean sound of NDFL amplifiers.

Crossover distortion associated with incorrect bias of the output stage is one of the most audibly annoying forms of distortion. Audio amplifiers based on Figure 2 sometimes have a type of crossover distortion that does not show up in normal measurements. Correct biasing of the output stage relies on close tracking of the thermally-compensated biasing device and the power transistors. At best the biasing device can be thermally bonded to the power transistor cases. More usually it is bonded to the heatsink, but there is no way it can

simultaneously sense the actual junction temperatures of all the power transistors. Under rapidly-fluctuating dynamic signal conditions, the junction temperatures may be wildly different from each other and from the case or heatsink temperatures, and therefore the biasing may be wrong.



(a) Figure 2 (conventional amplifier)



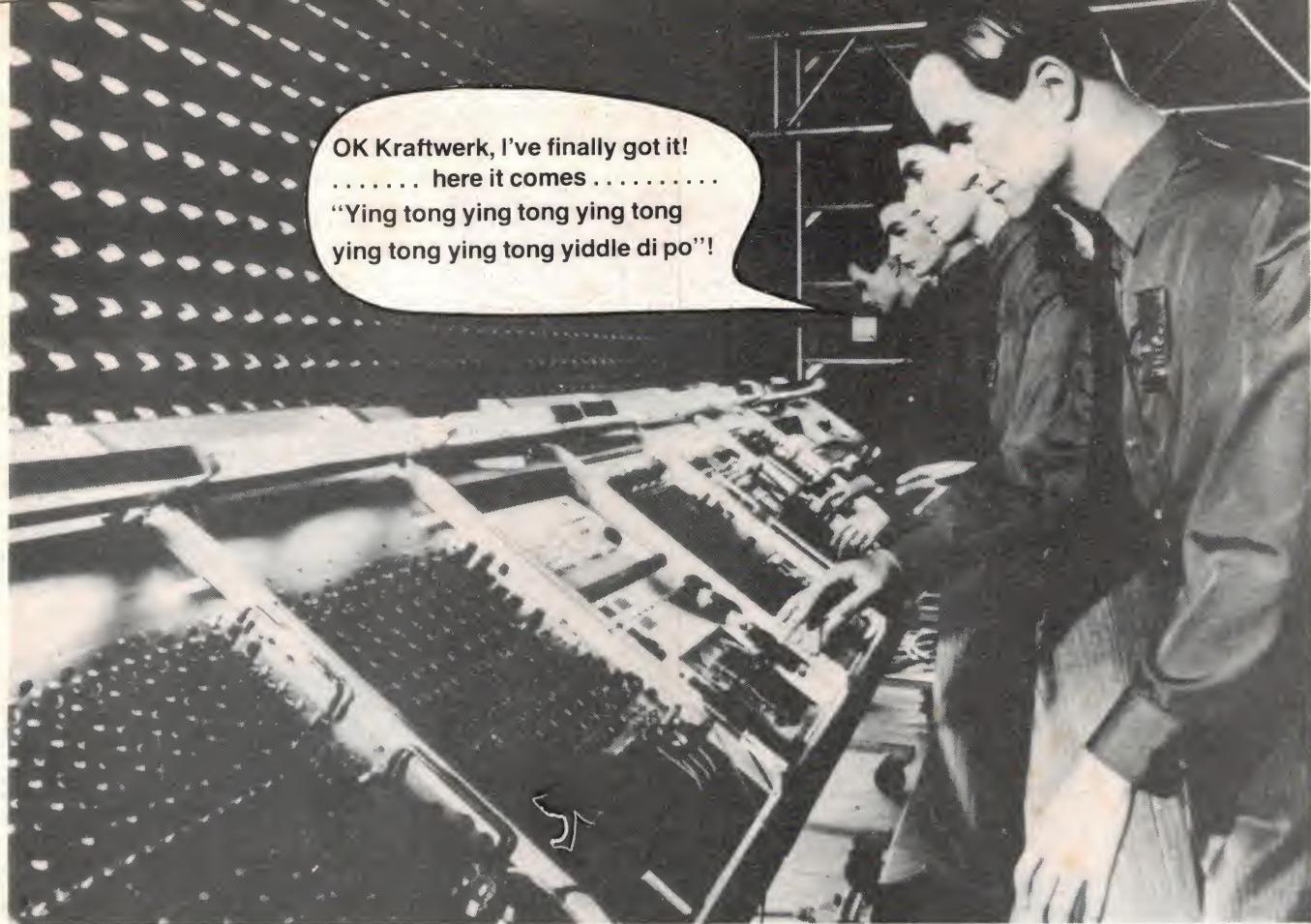
(b) Figure 10 (NDFL amplifier)

Figure 14. 2 kHz crossover distortion when bias is set wrongly

Figure 14 compares the static crossover distortion of Figures 2 and 10 when the bias is deliberately set 0.5 V too low. Dynamic mistracking of the biasing circuit should not introduce audible crossover distortion in an NDFL amplifier.

One final point. The NDFL technique maximises the return difference (and hence minimises distortion components) at frequencies up to  $1/\tau_0$ . Above this frequency the return difference falls away rapidly, and distortion rises. Choosing  $1/\tau_0$  to correspond to 20 kHz minimises audible-frequency distortion, but does not minimise ultrasonic distortion.

For example, a common specification for audio power amplifiers is their THD at 20 kHz. The harmonics of 20 kHz lie at 40 kHz, 60 kHz, 80 kHz, and so on. All are ultrasonic (and hence inaudible) and the NDFL technique does not minimise them. A measurement of THD at 20 kHz may therefore give a quite misleading indication of an NDFL amplifier's audible performance. Valid objective tests include the SMPTE and CCIF tests for two-tone intermodulation distortion, the proposed IEC test for TIM (20), Cordell's proposed three-tone test for TIM (21) and the proposed test for input-output intermodulation distortion IOD (9). The distinguishing feature of all these tests is that they measure the distortion at audible frequencies. ●



OK Kraftwerk, I've finally got it!  
..... here it comes .....

"Ying tong ying tong ying tong  
ying tong ying tong yiddle di po"!

Followers of that legendary British comedy team, The Goons, will recognise this. Apologies to fans of Kraftwerk.

## DREGS

THE HUMBLE MAIL BAG is a wondrously flexible product. And I don't mean in the purely physical sense, I mean in application. (This tale is specially dedicated to all our readers who have the misfortune of finding themselves guests of Her Gracious Majesty's Corrective Services establishments.) The humble mail bag has often been a target for abuse, ridicule — even satire. Yes, even satire. Well, it was mentioned in passing during The Goon Show's "Tales of Old Dartmoor". Wallace Greenslade introduces a scene with:

"The prisoners were busy at their tasks... mail bag sewing, warder bashing..."

But I think it was Ronald Biggs (alias, 'The Great Train Robber') who catapulted the lowly mail bag to fame — or maybe infamy.

Enough reverie. We recently had occasion to employ a mail bag in a hastily contrived scientific measuring machine. Our sister magazine, Sonics, was right on deadline and desperately needed to verify some figures quoted in an article. The figures related to tensile strength of guitar strings and the tension required to produce a given note for a certain length of string. But there was some confusion in the use of units. A little physics and mathematics gave result which, while seemingly correct, didn't feel right. Only one way to find out — get a guitar string and measure it!

Buried beneath the pile of half-edited articles, half-read magazines and half-completed projects on Roger Harrison's desk was a packet of guitar strings. One was selected for the destructive test and suspended at one end from a nail (the only one we could find was in ETI's lab and bent like a pretzel) hammered into the transom of Collyn Rivers' office door. To the lower end of the string we clamped a small

vise (to avoid kinking the string, thus lowering its tensile strength). Suspended from the vise was — the mail bag! Into the mail bag we put more and more Sonics magazines, increasing the number until the string broke (at about E above high C, I believe). It took a total of 55 of the Sonics 1982 Yearbook (approx. 25 kg). This proved a little low, but we were in the right ballpark, because the string was kinked at the vise. Everything then fell into place with the figures in the article.

Taking another string, we clamped the vise to it a measured distance down from the nail and, using a smaller mail bag, added the calculated number of Sonics mags to produce the right tension for a given note. It worked! Much to the rest of the staff's amazement — but we knew it would work all the time!

I wonder if what we did is "...an approved use of a mail bag"?

(Why Sonics magazines? Well, it seemed appropriate after all, and we needed a way of increasing the weight about half a kilogram at a time — and that's the weight of the 1982 Sonics Yearbook. Anyway, our office scales stop at 11 kg.)

# Power you can taste.



Sony's new TA-AX5 amplifier with memory is a high fidelity feast.

Its multiple memory lets you create your own acoustic "flavours." Bass and treble tone settings, turnover frequencies, high and low filter are all programmable.

At a touch you can instantly recall the recipe for bittersweet country, hot 'n' spicy rock, or a well-seasoned Stravinsky. And electronic displays graphically show you everything the amp is cooking up.

Sony's Audio Signal Processor means that every function is touch controlled. This knifes through the usual maze of audio circuitry for a streamlined design of the future. Pure and simple, it sounds delicious.

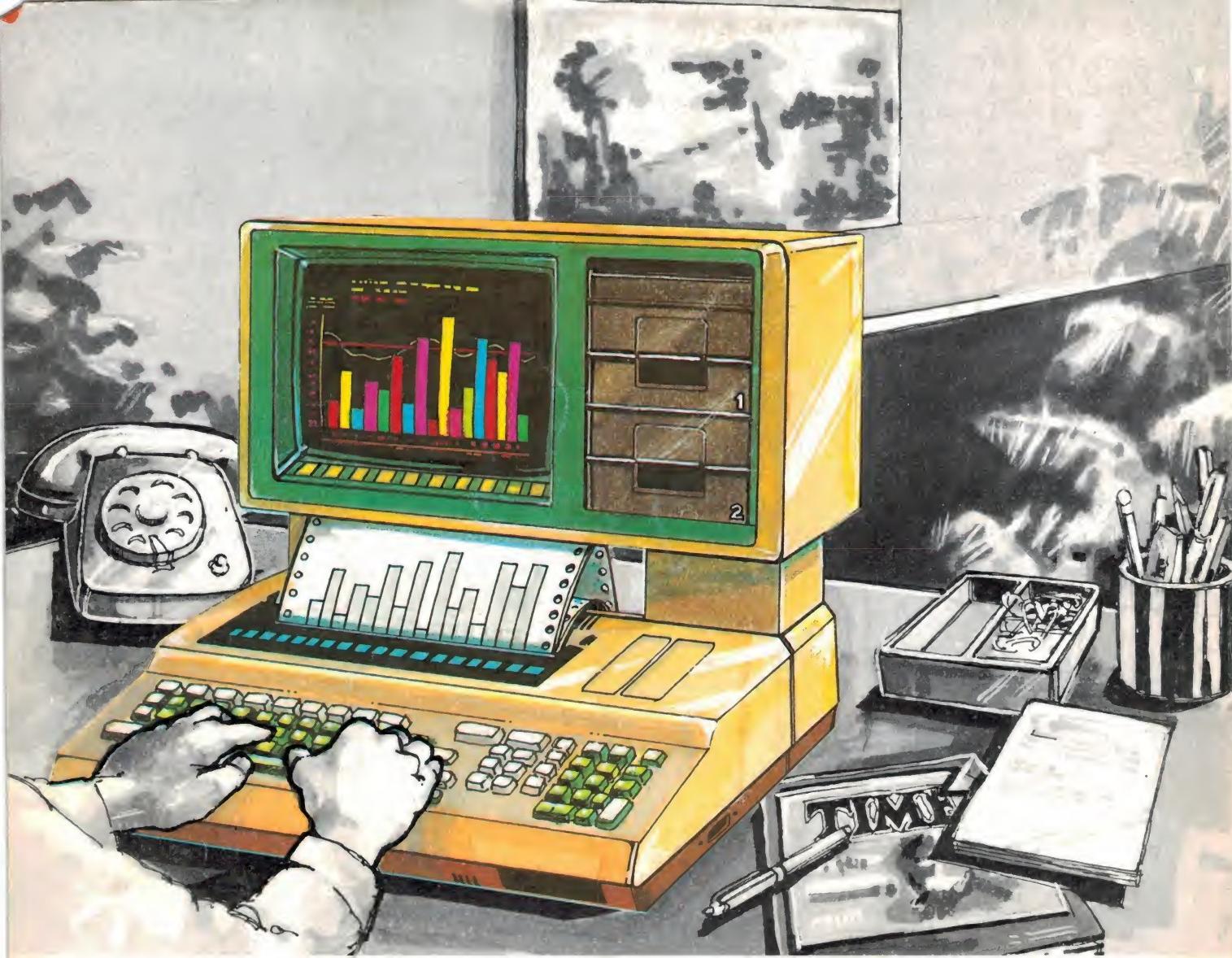
The ideal companion for this tasty new amplifier is Sony's ST-JX4 synthesizer tuner. Why not make a reservation for two?

TA-AX5



ST-JX4

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